CHAPTER 5. RAILWAY FACILITIES

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5.1 Present Situation

For construction of new elevated tracks above the existing ground railway line to be abolished, permanent facilities, modernized and strengthened as compared with existing ones, shall be planned.

For this purpose, the situation of the existing tracks and ongoing small improvements should be grasped.

5.1.1 Track and structure

(1) Railway Dimensions

The gauge of the Indonesian State Railway is of 1,067 mm, and it comes within the category of the narrow gauge.
Fig. 5.1.1 indicates the railway diagraph specified in the Construction Regulations of Indonesia State Railway, although the ballast thickness to correspond to 100 km/h is specified as 20 cm in the Construction Regulations and 25 cm for 120 km/h.
The form and thickness of the present roadbed and ballast are classified by the train running speed, but are also now reviewed from the view point of the train passing tonnage.

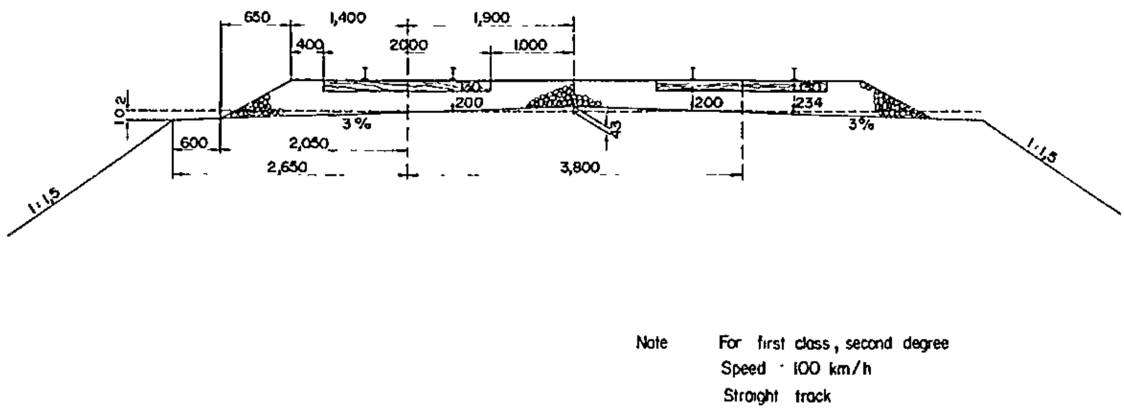
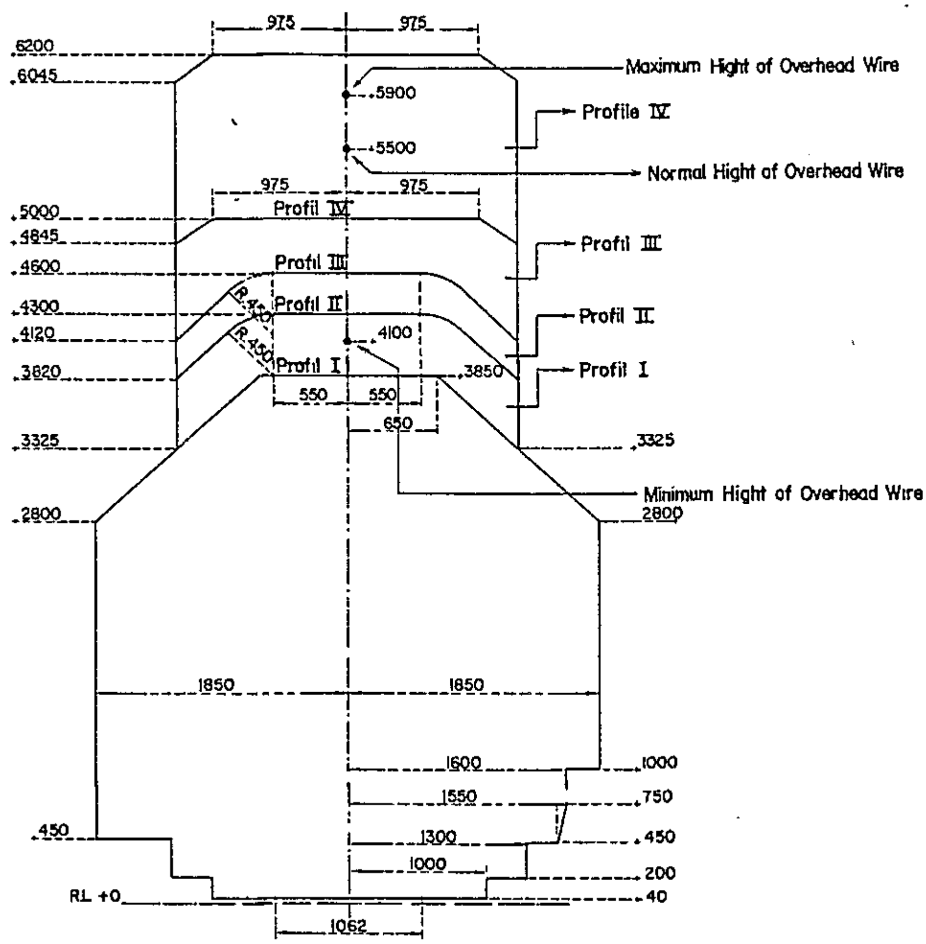


Fig. 5.1.1 Railway Dimension

(2) Construction Gauge

Fig. 5.1.2 shows the construction gauge of electric railcar specified in the Construction Regulations of Indonesian State Railway.



Profile I : Minimum profile for Bridge with speed restriction 60km/hour

Profile II : Minimum profile for TUNNEL and VIADUCT with speed restriction 60km/hour and for BRIDGE, no restriction

Profile III : Minimum profile for NEW VIADUCTS and new Constructions, exept tunels and bridges

Profile IV : Normal profile for Electric Car.

Fig. 5.1.2 Construction Gauge

(3) List of Bridges

The bridge structures are of the through girder. There is a great amount of rusting of the bridge steel in the densely populated areas, which is less pronounced and generally in a good state away from the inhabited areas.
The through girder type bridge between Jakarta Kota and Sawah Besar at Station 1 km 588 m of the bridge on the Down track is in good condition, but on the Up track at the mid-section of the beam the lower flange of the cross beams are badly rusted but other components are in a good state.
At Station 4 km 905 m between Sawah Besar and Gambir, the bridge on the Down track is of the through girder type, 16.48 meter single span and in a good state. However, the Up track bridge is constructed of a 6 meter long I-beam and a 13 meter long through girder. The I-beam bridge is in good condition but the through girder bridge rusted. The lower flange of the main beam is partly rusted at gusset plates and lateral bracing. The top and bottom flanges of the cross beams are excessively rusted.
The concrete railway bridge at station 9 km 573 m near the Manggarai Station is in good shape. The gravel stop barriers are broken off on both sides of the bridge and the concrete reinforcing steel bars are partially exposed.

(4) Plan and Profile

The distance between Jakarta Kota Station and Manggarai Station is of 9 km 954 m, and this section has been electrified and double tracked.
As for horizontal curves, although a radius of 225 m (R = 225), which is less than radius of 300 m (R = 300) specified in the construction regulation, is located in the vicinity of 0 km 650 m measured from Jakarta Kota Station, in other sections the radius is of over 300 m (R = 300). However, because of the fact that transition curves for connecting straight sections to curved section are not provided, the riding quality is inferior and high speed running is disabled.
As for vertical curves, ascending gradient is provided toward Manggarai Station because of the difference in height by about 10 m between Jakarta Kota Station and Manggarai Station. The maximum gradient specified in construction regulations is of 10‰, but the maximum gradient in this section is of 5 ‰ located in the vicinity of 9 km 000 m measured from Jakarta Kota Station.
Fig. 5.1.3 indicates the plan and profile of the section between Jakarta Kota Station and Manggarai Station. As the drawing is that of the year around 1940, a review should be made regarding particulars.

(5) Track Conditions

The extension of the track between Jakarta Kota Station and Manggarai Station is of 19 km 500 m, and R3 rails (33.4 kg/m) laid in 1880's are still used up to now.

The present track conditions obstruct the smooth running of train by the lack of strength of track and the lack of maintenance of track.
Main items of faulty maintenance of track are as follows;

- Rail joint

  Rail joint gaps are excessive at many places, and loose joints are also found at many places because of use of improper materials.

- Ballast

  Supplement and compacting of ballast are insufficient and suitable ballast thickness is not maintained.

- Adjustment of straightening of track

  As adjustment of horizontal and vertical alignment is improper, high-speed running is disabled.

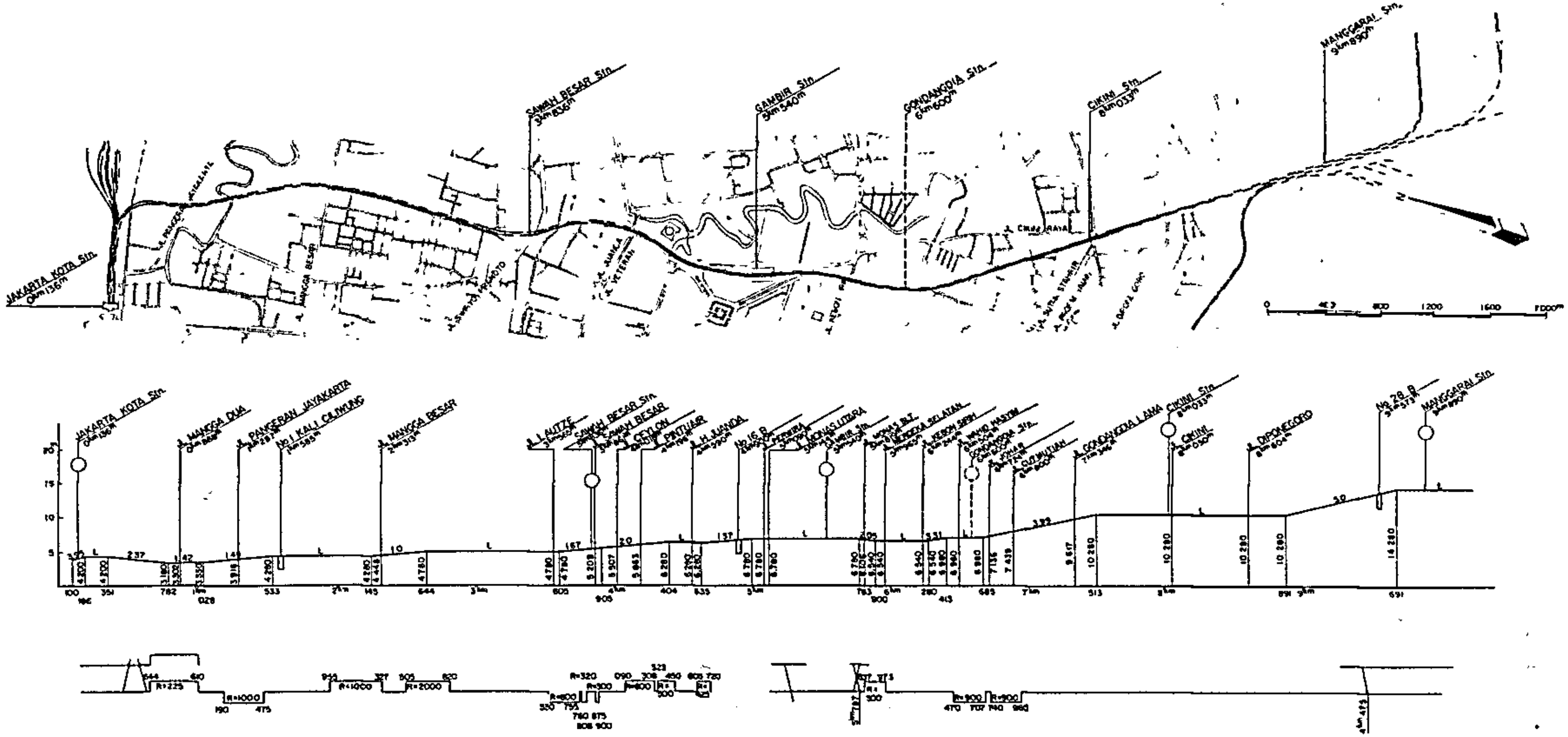


Fig. 5.1.3 Existing Plan and Profile (Data by PJKA of the year before 1940)

5.1.2 Station Facilities

There are three stations between the Jakarta Kota and Manggarai Stations namely Sawah Besar, Gambir, Cikini and the average distance between these intermediate stations is of about 2.4 kilometers. (Although platforms are equipped at Gondangdia Station, it was excluded from stations because no passengers are handled at this station.)

(1) Sawah Besar Station

The Sawar Besar Station is located at the point of 3 km 836 m measured from Jakarta Kota Station, and is next to J1. Sukarjo Wiryopranto. As this station faces a prosperous commercial and business area called Pasar Baru, it is considered that the number of customers who makes use of the railway will keep on increasing in the future.
Fig. 5.1.4 indicates the plan and cross section of this station. The platforms are the ones which has the height from the top surface of rails H = 430 mm, the distance from track center D = 1,350 mm and platform width W = 2,500 mm (Down platform) and 4,000 mm (Up platform). Because of narrow widths of them they are not capable of coping with increase of number of passengers in the future.

(2) Gambir Station

The Gambir Station is located at the point of 5 km 540 m measured from Jakarta Kota Station. It is a terminal station for intermediate and long distance trains. As it is also located at the center of DKI Jakarta, its degree of importance as a keypoint of transportation is high.
Fig. 5.1.5 indicates the plan and cross section of this station.
Handling of trains at the present is made by five platforms and four tracks. The height of the platforms are of H = 180 mm low, the distance from track centre are of D = 1,050 mm. These platforms are inconvenient for boarding and detraining because of the difference in level between the surface of the car floor and of the platform.

(3) Cikini Station

The Cikini Station is located at the point of 8 km 033 m measured from Jakarta Kota Station, and is located at the center of high class residential section.
Fig. 5.1.6 indicates the plan and cross section of this station. The platforms are the ones like those of Sawah Besar Station; H = 430 mm, D = 1,050 mm.

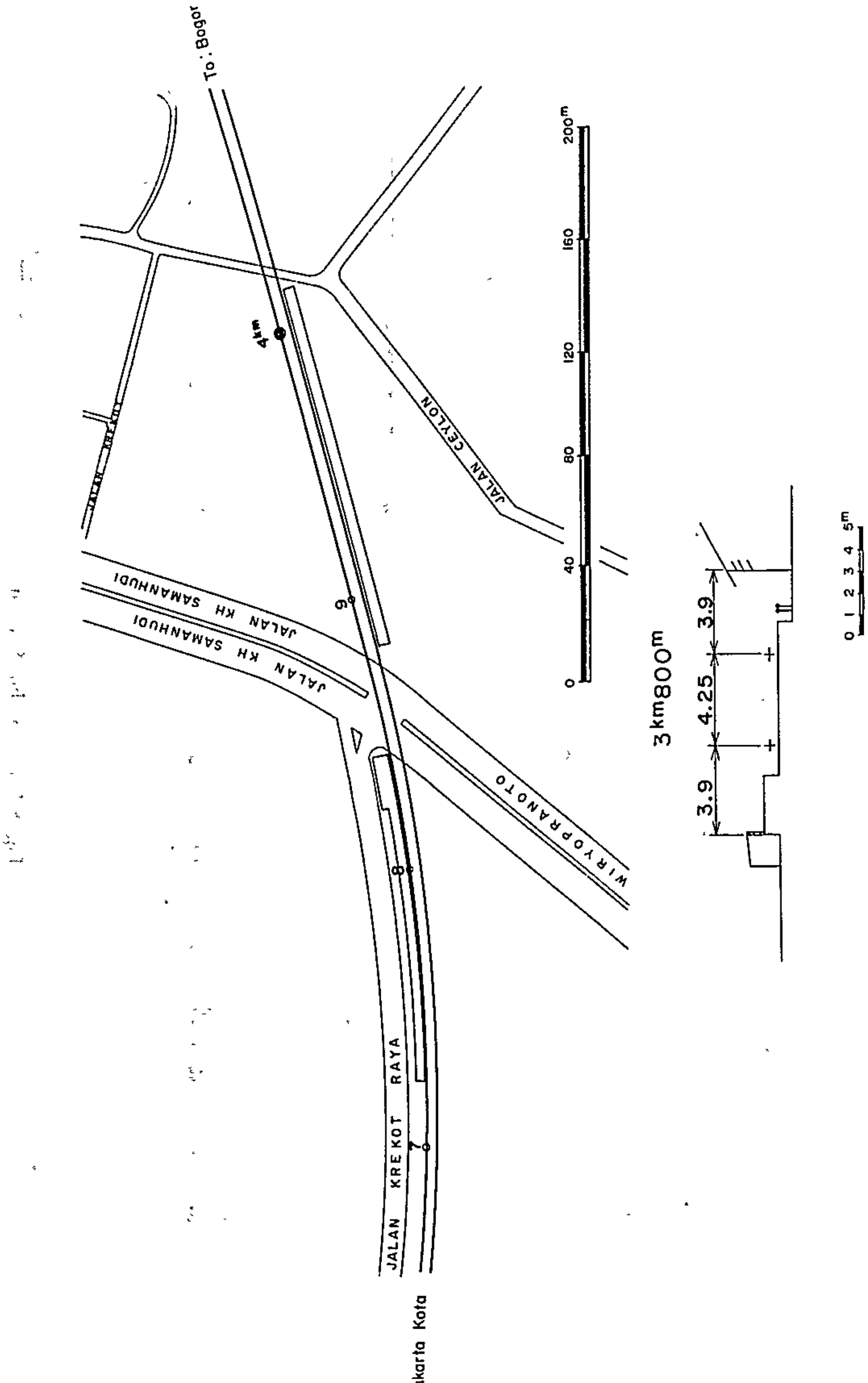


Fig. 5.1.4 Sawah Besar Station

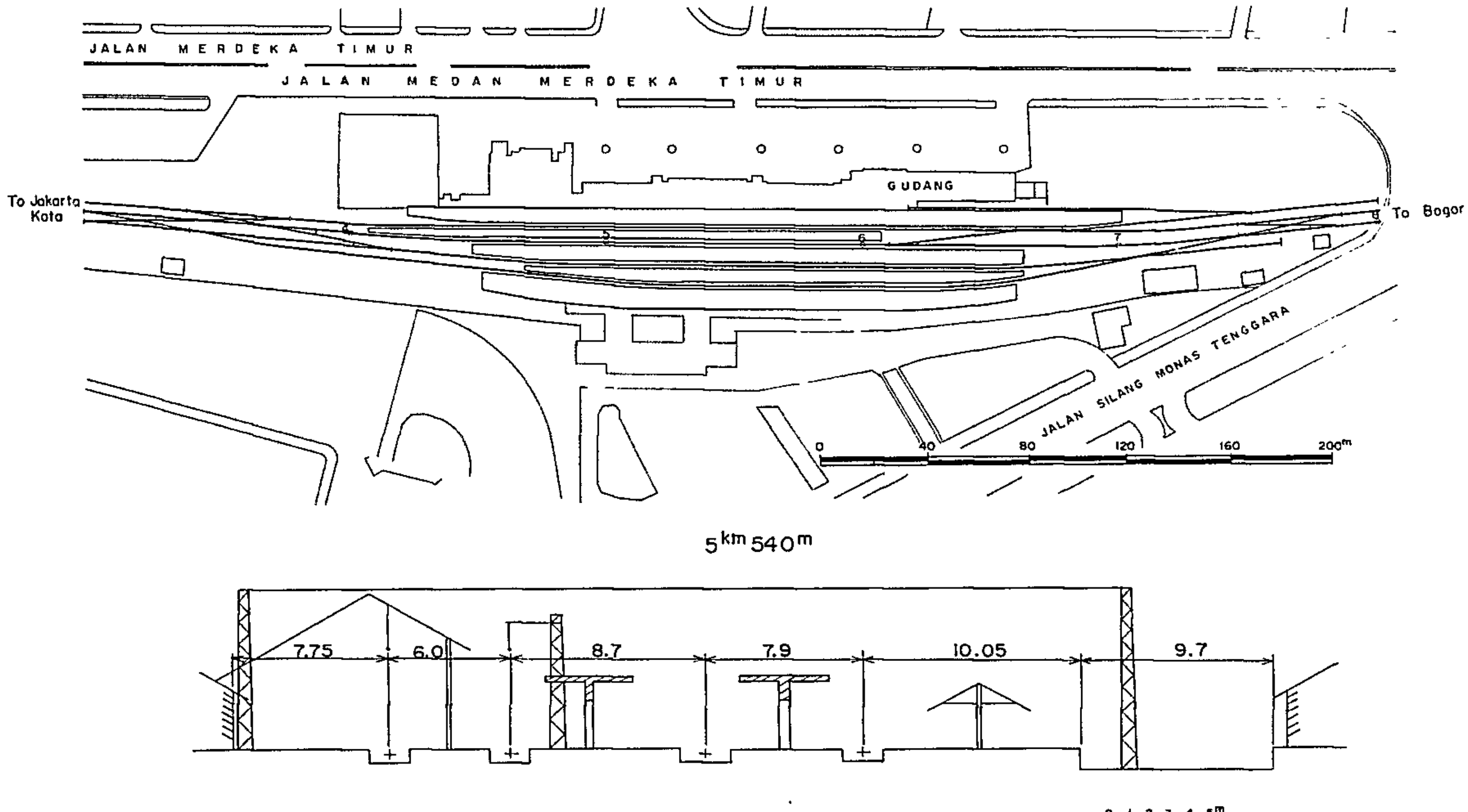


Fig. 5.1.5 Gambir Station

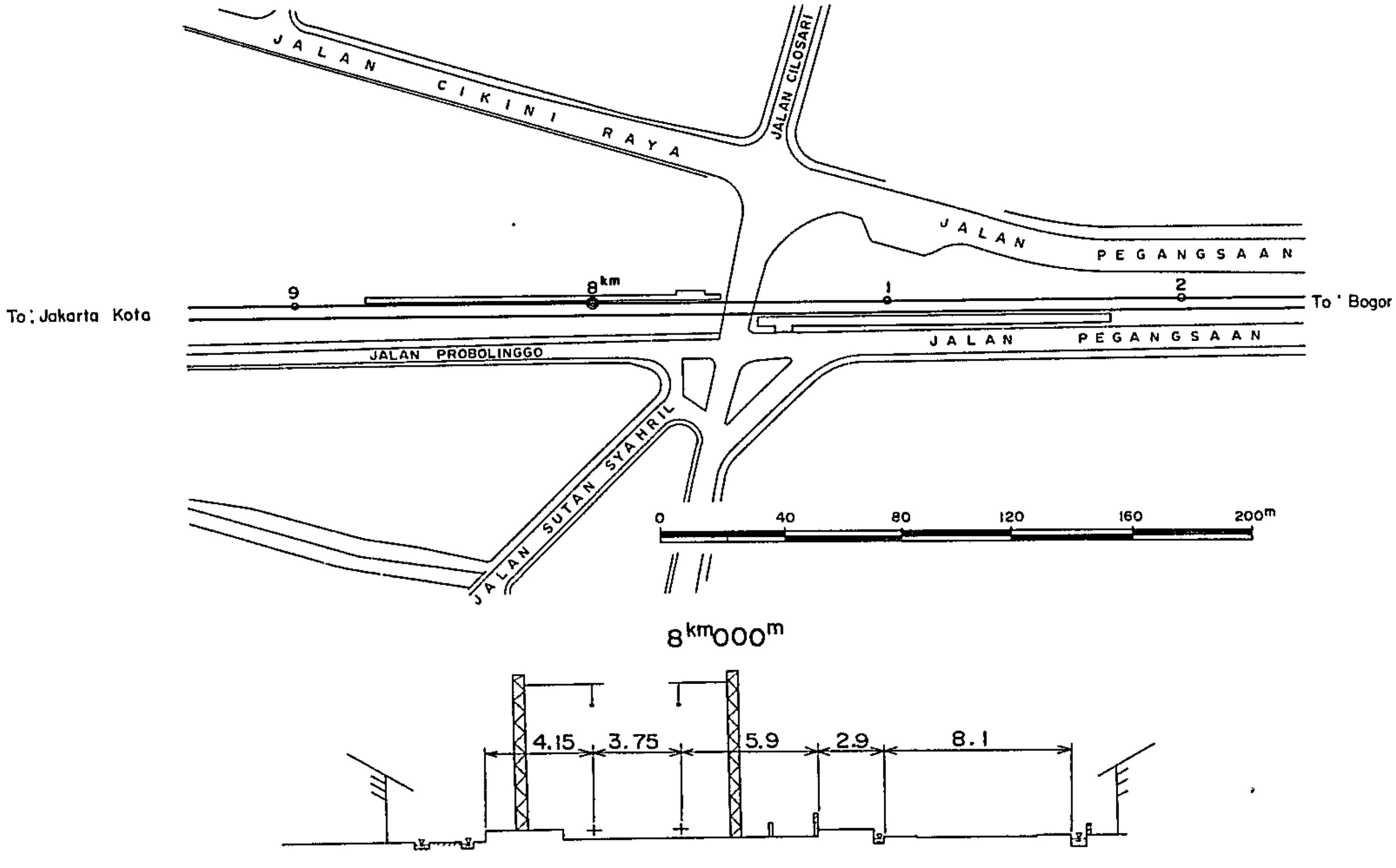


Fig. 5.1.6 Cikini Station

0 1 2 3 4 5m

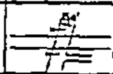
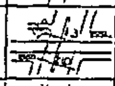
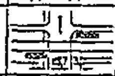
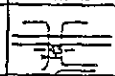
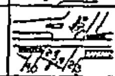
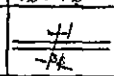
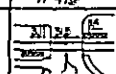
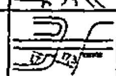
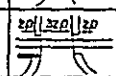
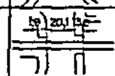
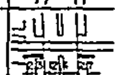
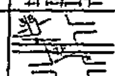
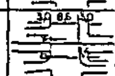
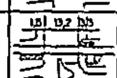
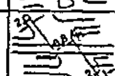
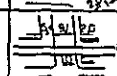
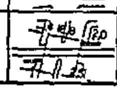
5.1.3 Crossing Facilities

There exists nineteen crossings between Jakarta Kota and Manggarai Station and the average distance is of 520 meter.

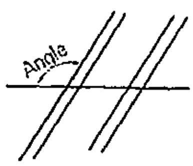
The average distance between crossings on the Central Line is shorter when compared to other city lines.

The crossing facilities are summarized in Table 5.1.1.

Table 5.1.1 Crossing Facilities

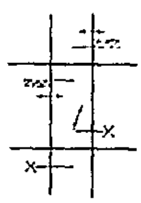
Name of Crossing	Distance	Layout	Width of road (m)	Angle	Barrier	Operater
Jl. MANGGA DUA	0k868		5.4	127°	B	6+1
Jl. JAYAKARTA	1k284		11.3	118°	A	6+1
Jl. MANGGA BESAR	2k313		15.7	90°	A	6+1
Jl. LARTZE	3k565		4.3	90°	B	3+1
Jl. SAWAH BESAR	3k861		43.4	135°	A	3+1
Jl. CEYLON	4k018		3.6	100°	B	3+1
Jl. PINTU AIR	4k196		4.2	120°	B	3+1
Jl. JUANDA	4k570		31.5	90°	A	6+1
Jl. PERWIRA	5k090		17.3	118°	A	6+1
Jl. MONAS UTARA	5k144		30.6	90°	A	6+1
Jl. MONAS SELATAN	5k819		32.0	90°	A	6+1
Jl. MERDEKA SELATAN	5k965		20.1	90°	C	6+1
Jl. KEBON SIRIH	6k249		12.4	90°	A	6+1
Jl. WAHID HASYIM	6k504		7.8	68°	B	6+1
Jl. JOHAR	6k724		8.6	90°	B	3+1
Jl. CUT MUTIAH	6k800		13.2	90°	A	6+1
Jl. GONDANGDIA LAMA	7k346		8.8	34°	A	3+1
Jl. CIKINI	8k050		9.1	90°	A	3+1
Jl. DIPONEGORO	8k604		15.8	97°	A	6+1

NOTE ·



Type of Barrier

A Barrier (Sliding gate)
B Carrier (Lifting gate)
C No Barrier



5.1.4 Electrification Facilities

The electrification facilities on the Central Line, constructed in 1920's, suffer serious deterioration. Electric traction became impossible once because of wear and tear power converters in substations.

The following electric facilities have been recently rehabilitated.

(1) Substation Facilities

1) Withdrawal of deteriorated power converters and new installation of rectifiers and transformers.
2) Replacement of some receiving circuit breakers and D.C. high speed circuit breakers.
3) Replacement of protective relays, especially new installation of ΔI-type protective relays on the feeding side.

(2) Overhead Line Facilities

1) Renewal of all contact wires and partial repair of catenaries.
2) Repainting on overhead line supporting poles.
3) Addition of some feeders.

(3) Lighting Power Facilities

1) Repair of high-tension distribution lines.
2) Improvement of low-tension facilities following the improvement of PLN (Perusahaan Listrik Negara).

As mentioned above, the facilities are being improved little by little but it is still insufficient. The Jakarta Kota ~ Manggarai section has the following problems.

1) As protective device, only ΔI-type relays are adopted on part of the section and there is no interlinked circuit breaking device. This situation can not be said to be sufficient.
2) The overhead line is equipped with lightning arresters, of which effect is lost and which are not repaired.
3) Maintenance for return circuit is not adequate, because rail bond is lacked and rail bottom is buried in the earth.
4) Electrolytic corrosion is observed on the rail.
5) The grade of electric facilities is not good at stations including Gambir Station.

5.1.5 Signalling and Telecommunication Systems

(1) Signalling System

The existing signalling system for protecting trains and for securing safe for train operation is as follows:

1) The tokenless type block system is now used as the block instrument, but it cannot perform its full functions because of its deterioration and lack of maintenance. Particularly, magnetic treadles used for detection of trains are in unusable state, and so signal operators are charged to discern passage of trains through detection points for operating the block control.
2) Double wire type semaphore signals controlled by concentrated mechanical signal levers are widespread as railway signals. Although home signals, starting signals and block signals are relatively well maintained, distant signals have been deteriorated, and are in the state that does not permit them to use because of damage to wire carriers, depression of carrier bases and other problems.
3) Many double slip crossings are used as turnouts at Gambir Sation to permit establishment of multiroute composition. Each point switch movement is controlled through double wires by the operation of concentrated mechanical levers.
4) Interlocking between railway signals between a railway signal and point switch movements and among point switch movements themselves accomplished by the Siemens-Halske signalling system, which is a first class interlocking device.
5) Watchers are assigned to all level crossings between Jakarta Kota Station and Manggarai Station for operating sliding gates or arm type barriers. Each watcher is notified of approach of a train and approaching direction by ringing of an announcement bell installed by the watcher's shed. This bell is controlled by the operation of hand-turning generators installed at adjacent stations.

(2) Telecommunication System

The existing telecommunication system which is the means for transmission of data and information for railway transportation is as follows:

1) Although underground cables are used in the vicinity of Gambir Station as telecommunication lines, aerial bare wires (iron wires) are generally used in other sections. These aerial wires are strung in by such a method that crossarms for four wires are attached to poles made of wood or old rails and insulators made of either ceramics or glass are mounted on these cross arms for stringing of wires. As they are strung by such a method, reduction of insulation resistance and increase of transmission loss are conspicuous because of damage to insulators, contact of wires with trees, houses and so forth.

2) The majority of telephone facilities are antiquated magneto systems, and their speech quality is not good at all due also to the situation of telecommunication lines described above and to proximity to power lines. Accordingly, Morse telegraph equipment are still important equipment as auxiliary equipment for telephone.
On the other hand, an automatic exchange made by Philips has been introduced as a private automatic exchange system, and improvement of telecommunication lines for allowing full exhibition of its functions is being planned.

3) UHF radio equipment made by Telefnken have been introduced as the long distance circuit transmission equipment, and a VHF system is being used as the dispatching telephone system.

5.1.6 Projects Execution by Intermediate Program

An overall plan of the Intermediate Program for the Improvement of the Urban Rail Transportation System in the Jakarta Metropolitan Area has been established.

The Intermediate Program was started in 1976 and is scheduled to finish by 1983.

From the Intermediate Program, summarized below is the investment program for Central line, e.g. between Jakarta Kota Station and Manggarai Station.

(1) Fencing along the Central Line

Due to the present condition of right-of-way, which is crowed by the illegal occupation of right-of-way by houses, and to protect further the right-of-way from urban development along the railway, fencing along the Central Line is programmed to be executed.

(2) Road Level Crossings

Due to unsatisfactory condition of road level crossings and to provide undisturbed train operation from traffic flow and also greater safety.
Pavement of road crossings and installation of automatic crossing barriers will be made in order to solve such situations.

(3) Corrective Measures for Embankments and Cuts

Side slopes of several banking and cutting in Central Line should be reformed to its normal function.

(4) Corrective Measures for Bridges

The bridge at Station 4 km 905 m between Sawah Besar and Gambir on the "up" track, needs corrective measures to replace one each 'through girder' 13 meter long.

(5) Tracks

Track condition in Central Line is not good, due to widening of sleeper spacings, poor condition of sleeper, and loss of ballast which has further caused a loss of track strength.
Therefore, it is necessary to strengthen the track structure and improve the condition of the tracks.

Plans of Railroad rehabilitation are as follows:
The longitudinal alignment of the rail top elevation will be reformed keeping the depth of ballast, and after renewal of track panel maintaining surfacing by general tamping, Type R-14A rails (42.59 kg/m) with welded lengths of 85 meter will be used. Elastic fasteners will be increased to 1,500 per km. The ballast will be of a standard thickness of 200 mm.
The total amount of rehabilitation of Central Line, route length and track length, is of about 16.00 km.

(6) Electrification Facilities

As a part of the Intermediate Program, the following improvement and installation of electrification facilities are executed.

1) Installation of new substations between old substations, following replacement of power converters in old substations.
2) Electrification work of the Jakarta Kota ~ Kampung Bandan ~ Manggarai section on the Western Line.
3) New installation of remote control system and related telecommunication circuits for substations.

However, these programs are somewhat delayed and involve the following problems with the function.

1) Improvement by the Intermediate Program only secures the capacity for operation of 4-railcar electric trains.
2) The capacity of rectifiers is insufficient for operation of 8-railcar electric trains which will be required in future, and power failure will, in the worst case, occur in substations.
3) The number of circuits for feeding circuit breakers is insufficient. T-type feeding in Gambir Substation renders protection difficult.
4) Protective function is not satisfactory due to lack of interlinked circuit breaking device.
5) Old circuit breakers with insufficient interrupting capacity are still used.
6) It is difficult to cope with occurrence of abnormal condition, from lack of established power dispatching system.

7) Telecommunication circuit for the interlinked circuit breaking device is not adequately elaborated.

From long-range vision, the study team proposes further modernization, improvement and strengthening of the existing facilities in conjunction with civil work planned by the Central Line Track Elevation Work Project. The detailed proposals are mentioned later.

(7) Signalling and Telecommunication Systems

1) Signalling facilities

Planning of signalling facilities is to improve level crossing protection facilities at 19 places along the tracks for the purpose of securing safety of train operation and easing congestion of road traffic. The outline is described below.

a) Level crossing signals which give warning of approach and passing of trains to pedestrians and vehicle drivers in the vicinity of level crossings by means of flashing lights and sounders will be installed.
b) Arm type barriers which physically and efficiently separate road traffic flows from level crossings will be installed.
c) Track circuits or train detectors which detect presence of trains approaching level crossings and quickly transmit the information will be installed.

2) Telecommunication system

Planning of the communication system is to accomplish rationalization of railway management and improvement of efficiency of train operation through introduction of modern equipment. Its outline is described below.

a) Laying of telecommunication cables for reinforcement of telecommunication lines, improvement of transmission performance and for elimination of need for maintenance.
b) Installation of PCM cable carrier equipment which are hardly affected by noise distortion, capable of transmitting data at high quality and are suitable for high speed data circuits.
c) Complete provision of train dispatching system for performing train operation at high efficiency, electric power dispatching system for electric operation and signal/telecommunication dispatching system for maintenance of signalling and telecommunication facilities.
d) Installation of facsimile equipment for transmission of train operation dispatching data and general station operation and management data and commands.
e) Installation of train radio system which permits direct communication between the train operation dispatching office and train operators to permit prompt seizure of train operating conditions at all times.

5.2 Facilities Planning

In this paragraph,. technical feasibility of track elevation work is studied and alignment planning and facilities planning for selected alternatives are set up.

5.2.1 Selection of Method of Grade Separation

Method of grade separation can be classified into the elevation type and the underground type. The type of structures are as follows in general;

Elevation type	:	Bridge system or embankment
Underground type	:	Underground structure (tunnel) or open ditch

Embankment and open ditch were excluded from the object study because of structural problems such as land and drainage from the track and also from the standpoint of effective utilization of land in the metropolis.

The grade separation structure may be divided into underground or elevation type. This plan adopts the elevation type after the comparative study of the following points, independently of the fact that underground type costs are generally higher.

(a) Necessary space for construction work can be secured.

(b) The ground condition up to a depth of 15 to 20 meter is relatively unfavourable with high ground water level and the ground level is close to zero at the proposed site.
 - Tunnel structure deforms due to differential settlement in the case of weak ground.
 - Difficult countermeasure for water leaks from the joint of tunnels.

(c) It is not desirable that DL and DC of intermediate and long distance trains enter into a tunnel because of their exhaust fumes.

(d) Expenses of a huge amount are required for ventilation system.

5.2.2 Study on Method of Track Elevation

(1) Selection of Method of Track Elevation

To establish the criteria for construction planning of the track elevation, the study team established the assumption for train operation as mentioned below:

- In the case of suspension of train operation
- In the case of continuity of train operation

It will be possible to propose eight cases for construction planning in consideration of above assumption. Table 5.2.1 explains the construction planning for each case.

The study team recommends three alternatives in consideration of train operation, difficulty in construction and effectiveness of investment.

The selected alternatives are as follows:

- Alternative A : Partial suspension of train operation (Commencement of construction work; between Jakarta Kota Station and Gambir Station)
- Alternative B : Single Track Operation
- Alternative C : Double Track Operation

(2) Study on Method of Execution of Works

Alternative A : This alternative is to divide the section in which track elevation works is executed into two sections, and to suspend train operation and to dismantle railway facilities in one section at a time during execution of track elevation works on the right site of the existing track in order to avoid troubles related to the land.

Train operation in the sector between Jakarta Kota Station and Gambir Station is suspended during the construction works of the first period, and track elevation works is executed in this sector. Therefore, when double track operation is made, the trains from Manggarai Station are shuttled at Gambir Station. Accordingly, it is necessary to execute transition of track in the yard of Gambir Station prior to commencement of the track elevation work.

On completion of the work of track elevation between Jakarta Kota Station and Gambir Station and after commencement of train operation in this sector, the train operation between Gambir Station and Manggarai Station is suspended and the works of track elevation of this sector is executed. Track elevation of the entire sections is completed as a result.

The relationship between the existing track and standard bridge structure for elevated tracks is shown in Fig. 5.2.1, and the temporary tracks in Gambir Station are shown in Fig. 5.2.2.

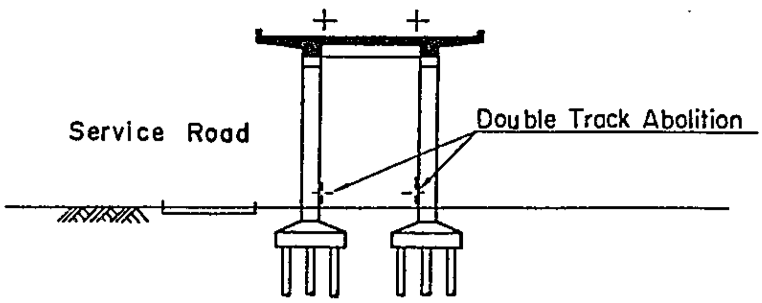
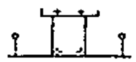
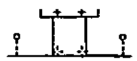
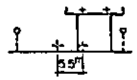
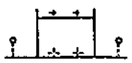
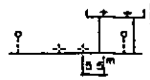
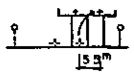
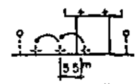
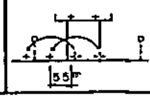


Fig. 5.2.1 Alternative A : Suspension of Train Operation

Table 5.2.1 Construction Planning for Each Case

	CASE	GENERAL	CLEARANCE UNDER THE ELEVATION	DISTANCE FROM EXISTING LINE	INVESTMENT COST		CONSTRUCTION DIFFICULTY	CONSTRUCTION PERIOD	PASSENGER SERVICE	EVALUATION
					LAND ACQUISITION	CONSTRUCTION COST				
1. SUSPENSION OF TRAIN OPERATION										
ALL SECTION SUSPENSION (JAKARTA KOTA — MANGGARAI)	1		FOR ROAD	0m	◎	◎	◎	◎	×	NO RECOMMEND
PARTIAL SUSPENSION (JAKARTA-KOTA — GAMBIR) GAMBIR - MANGGARAI	2		FOR ROAD	0m	◎	◎	◎	△	△	RECOMMEND
2. CONTINUNITY OF TRAIN OPERATION										
SINGLE TRACK OPERATION	3		FOR ROAD	+ 5.5m	○	○	○	○	○	RECOMMEND
TRACK ELEVATION ABOVE EXISTING LINE	4		FOR RAILWAY	0m	◎	×	×	×	◎	NO RECOMMEND
PARALLEL WITH EXISTING LINE	5		FOR ROAD	+ 5 5m	△	△	○	○	◎	RECOMMEND
PARALLEL WITH EXISTING LINE (ONE BY ONE)	6		FOR ROAD	+ 5 5m	○	×	△	×	◎	NO RECOMMEND
ONE TRACK RE-ROUTING	7		FOR ROAD	+ 5 5m	○	×	○	△	◎	NO RECOMMEND
TWO TRACKS RE-ROUTING	8		FOR ROAD	+ 5 5m	△	×	○	△	◎	NO RECOMMEND

NOTE ◎ EXCELLENT DEGREE ○ BETTER DEGREE △ NORMAL DEGREE × WORST DEGREE

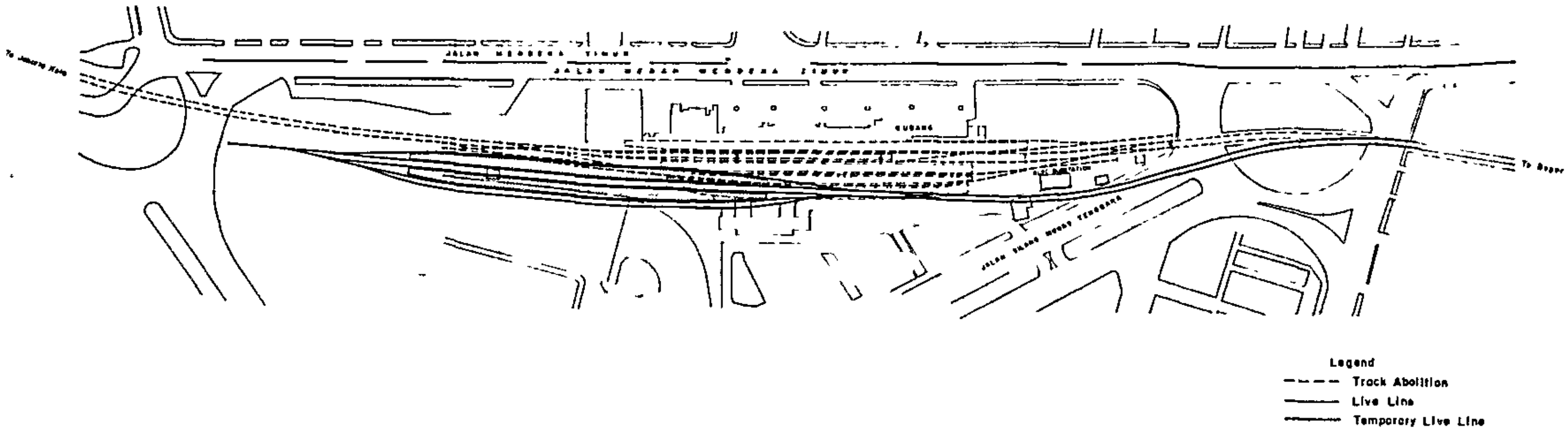


Fig. 5.2.2 Alternative A : Temporary Tracks in Gambir Station

Alternative B : This alternative accompanies land acquisition, but it is minimized. That is, the elevated tracks are constructed in proximity to an existing line while train operation is continued by making use of the other single track.

If one track is removed and single track train operation is commenced instead of the current double track operation, the track capacity of the line naturally becomes insufficient and the operating interval becomes longer. Besides establishment of new passing equipment at Sawah Besar Station and Cikini Station, full transition of track in the yard of Gambir Station is required as countermeasures. Although it is possible to commence the track elevation works over the entire section at a time, care should be exercised in the security of safety by providing protective fences of the line between the work site and the existing track, as the work is executed in proximity to the existing track.

The relationship of position between the existing track and standard elevated track structure is shown in Fig. 5.2.3, and sketches of temporary tracks at Sawah Besar, Gambir and Cikini Station are shown in Fig. 5.2.4 through Fig. 5.2.6.

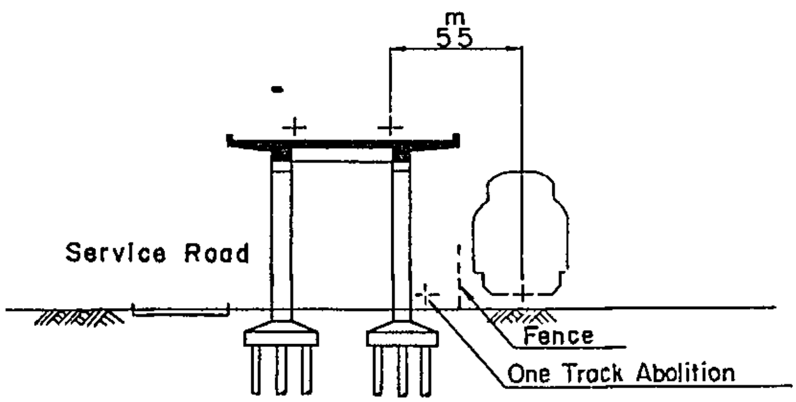


Fig. 5.2.3 Alternative B: Single Track Operation

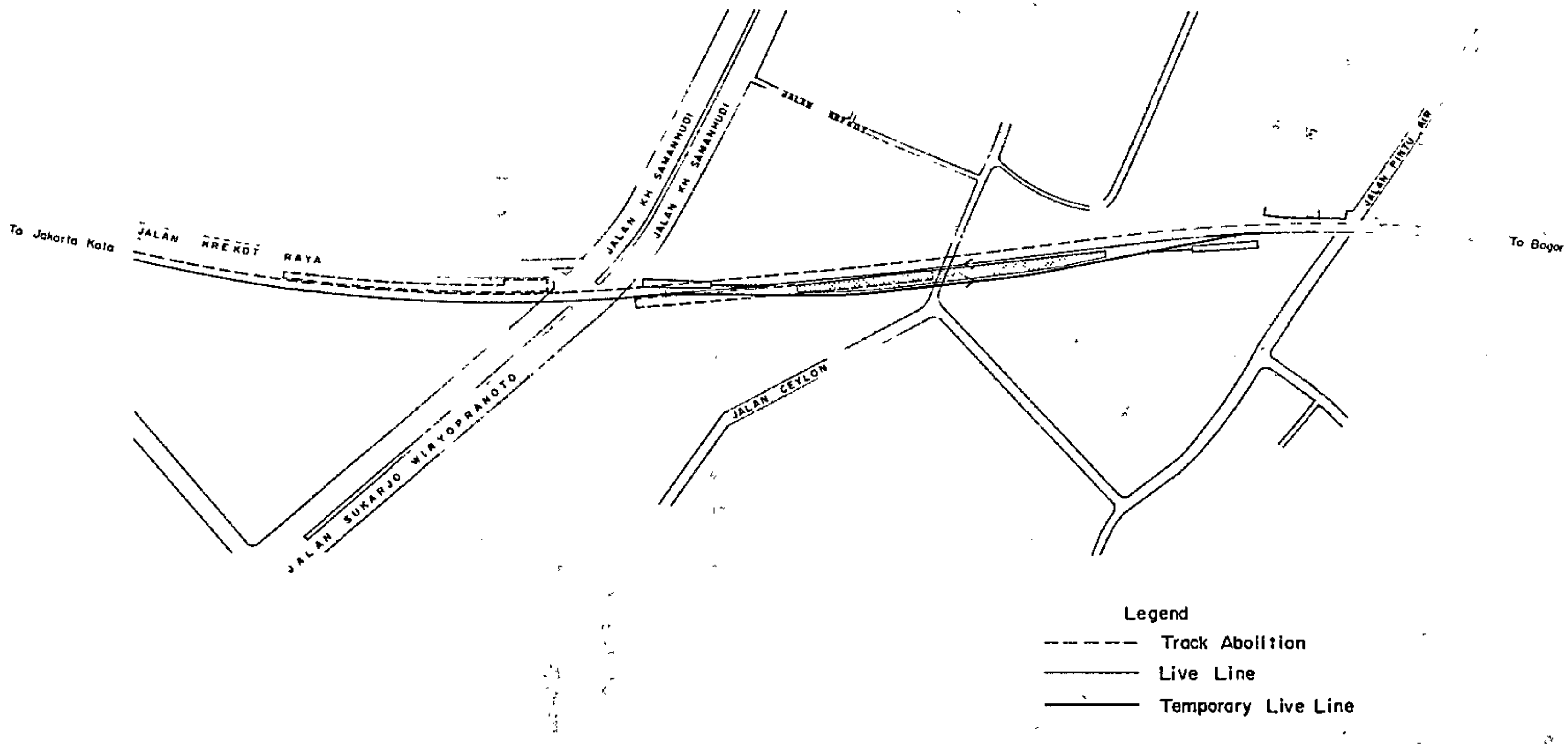


Fig. 5.2.4 Alternative B : Temporary Tracks in Sawah Besar Station

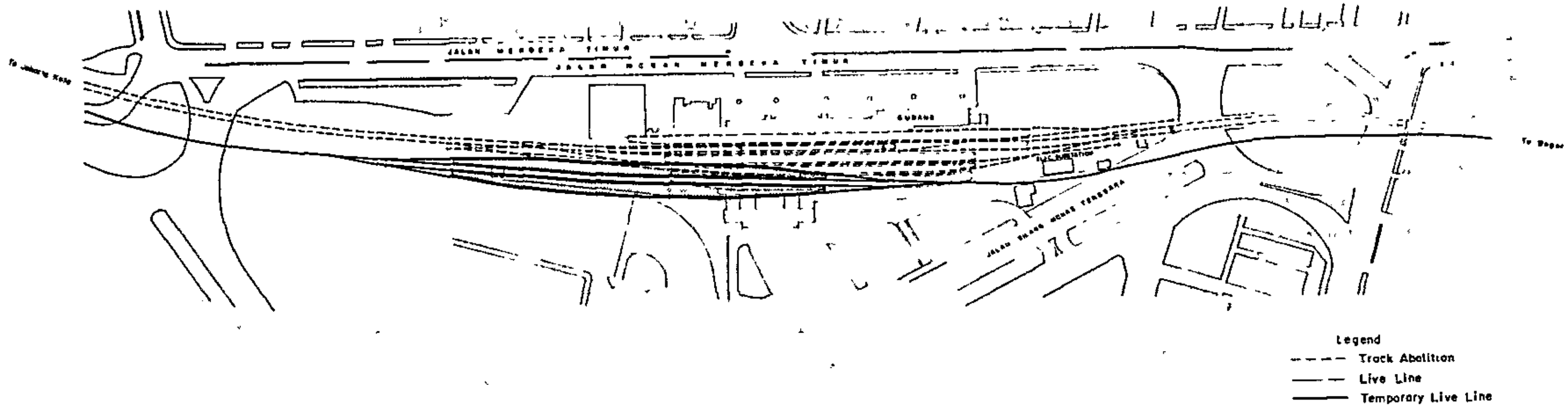


Fig. 5.2.5 Alternative B : Temporary Tracks in Gambir Station

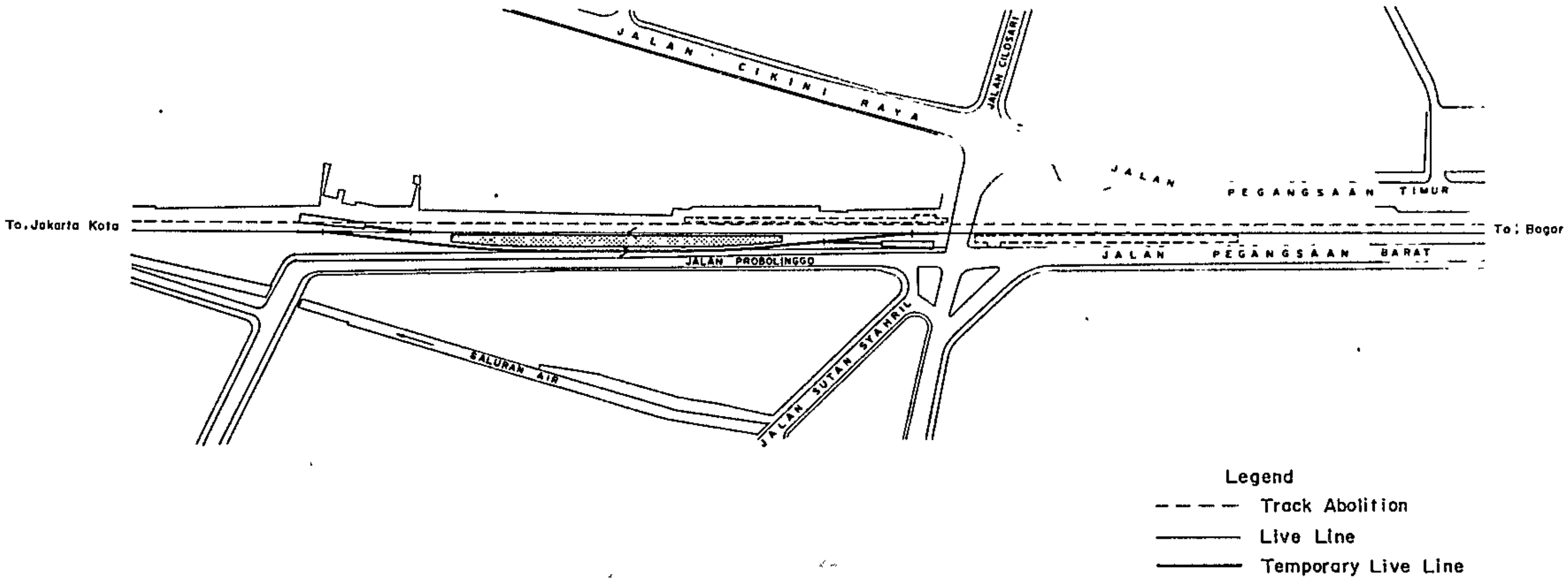


Fig. 5.2.6 Alternative B : Temporary Tracks in Cikini Station

Alternative C: This alternative is to execute the works of construction of elevated track while double track train operation is continued as before, although there is a great problem of lands acquisition. It has such advantages as providing high degree of convenience to passengers and that it is possible to secure the space for future track addition in the land after dismantle of existing tracks after completion of elevated tracks.

As for the order of execution of work, full transition of track in Gambir Station is required like other alternatives. Like Alternative B, it is possible to commende the construction works along the entire section simultaneously. But because of the fact that construction works is executed in proximity to existing tracks, care should be exercised in the security of safety by providing protective fences or the like between the work site and the existing tracks.

The relationship of position between existing tracks and standard elevated track structure is shown in Fig. 5.2.7.

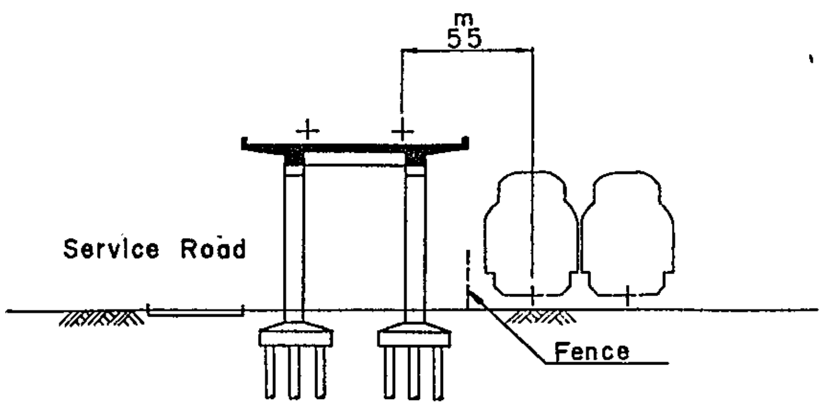


Fig. 5.2.7 Alternative C: Double Track Operation

5.2.3 Alignment Planning

(1) Design Conditions

Planning of plan and profile alignment of tracks is based on the standard shown in Table 5.2.2.

Table 5.2.2 Standard for Plan and Profile

Item		Standard
Min. radius of curvature	Main track	300 m (210)
	Turnout curve behind frog	240 m (160)
	Section along platform	500 m (400)
	Side track	160 m (turnout curve behind frog)
Max. gradient	Main track	10 ‰ (14 ‰)
	Main track in station	2.5 ‰ (3.5 ‰)
Track-center distance	Outside of station	4.0 m (3.8 m)
	Inside of station	4.0 m (3.8 m)
Track	Bearing capacity K load	K – 16
	Ballast thickness of track	250 mm
	Weight of Rail	N 50 kg/m equivalent
	Sleeper	Wooden
	Turnout	10 #
	Gauge	1067 m
Width of formation level (from track center; respectively)		2.75 m
Bridge bearing capacity (standard design load)		KS – 16
Platform	Between platform edge and track center	1.6 m
	Platform width	3.0 m minimum if both sides are used 2.0 m minimum in other cases
	Platform height	0.95 m
	Platform length	270 m
	Maximum design speed	90 km/h
	Maximum elevation	105 mm
Other	Transition curve	Cubic parabola $L_1 \sim L_3$ whichever is the logest: $L_1 = 0.8C$, $L_2 = 0.01CV$, $L_3 = 0.009CdV$ L_1, L_2, L_3 is transition curve length (mm). C = net elevation (mm) Cd = elevation unfixed value (mm) V = maximum train running speed (km/h)

Item		Standard
Other	Vertical curve	4,000 m in the case where radius of horizontal curve R ≧ 800 m; 3,000 m in other cases.
	Overhead clearance at the place of intersection with road	5.1 m or more

Note: 1 Inside of ( ) is applicable to an unavoidable cases.
2 Concrete sleepers and long rails will be suitable for the consideration of environment in the future, but wooden sleepers are adopted.

(2) Alignment Planning

(a) Alignment planning

Alternative A through Alternative C were selected regarding the method of execution of construction works as a result of field survey. With Alternative A, althogh it is necessary to purchase land for elevated track structure as the structure will be constructed almost at the position of the existing tracks, purchase of land for roads of construction is required. Alternative B and Alternative C, on the other hand, accompany purchase of land to a certain extent because construction works should be executed in proximity to existing track while operation of entire or a part of existing tracks kept operated. Therefore, all of the alternative require purchase of land. But whether the elevated track structure is to be constructed on the east side or west side of the existing line should be determined based on the judgement of the extent of influence of articles which exert influence, relative case of construction works, the amount of construction expenses, and management, maintenance, form of the structure and so on after completion.

As the matters which should be considered for selection of the route, availability of service road and open spaces which can be used for construction works, and presence of water courses, canals and other obstructive articles which cause problems to construction works are summarized in Table 5.2.3 and Fig. 5.2.8. As seen in these table and figure, it is more advantageous to construct the elevated track structure on the east side (left-hand side toward Manggarai Station) of the existing line because many service road are available and no water courses or the like are located. With the factors described above taken into account, plane alignment was decided based on the assumption to construct the elevated track structure on the site of the existing line with Alternative A and to construct elevated track structure on the east side in parallel with the existing line with Alternative B and Alternative C.

Furthermore, the track layout of Gambir Station is assumed to be composed of two island type platforms and four tracks and the track layout of other stations is assumed as separate platforms.
A sketch of track layouts of Gambir Station and other stations are shown in Fig. 5.2.9 and places in question for the alignment planning are shown in Table 5.2.4.

Table 5.2.3 Comparison of Selected Routes

Section	Section Length (m)	East Side of Existing Line		West Side of Existing Line	
		Service Road and Open Space	Obstructive Article	Service Road and Open Space	Obstructive Article
0 k 730 m (beginning point) – 1 k 050 m	320	None	Building	None	Building
1 k 050 m – JL. Jayakarta	390	Available	None	None	Building
JL. Jayakarta – 1 k 590 m	150	None	Building	None	Building
1 k 590 m – 2 k 130 m	530	None	Building	None	Water course and building
2 k 120 m – JL. Mangga Besar	190	Available	None	None	Water course
JL. Mangga Besar – 3 k 550 m	1240	(open space is available) Available	None	Available	Water course
3k 550 m – JL. Samanhudi	310	Available	None	None	Building
JL. Samanhudi – JL. Juanda	730	None	Building	None	Building
JL. Juanda – 5 k 000 m	410	None	Mosque	None	Canal
JL. Merdeka SEL – JL. Wahid Hasyim	540	None	Building	None	Building
JL. Wahid Hasyim – JL. Cut Mutiah	300	Available	Building	Available	Building
JL. Cut Mutiah – 6 k 960 m	160	None	None	Available	None
6 k 960 m – 7 k 330 m	370	Available (minor)	None	None	Water course
7k 330 m – 7 k 590 m	260	Available (minor) open space is available	None	None	Water course
7 k 590 m – JL. Cilosair	460	None	Building	Available	None
JL. Cilosari – JL. Diponegoro	550	Available	None	Available	None
JL. Diponegoro – 8 k 980 m	380	Available (open space is available)	None	Available	None
8 k 980 m – 9 k 470 m (end point)	490	None	Building	None	Building

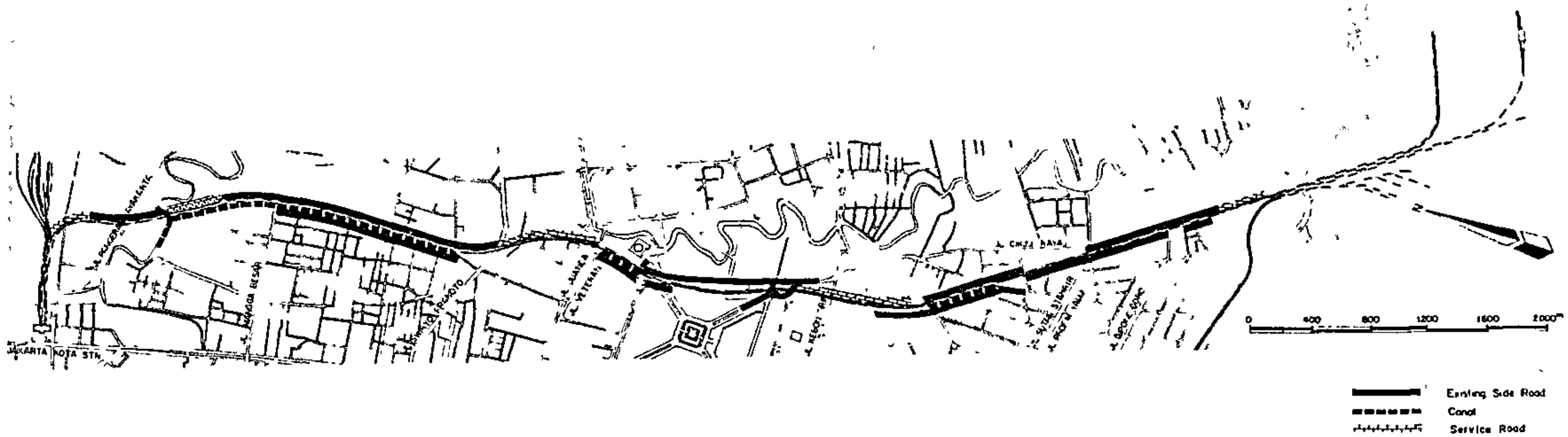
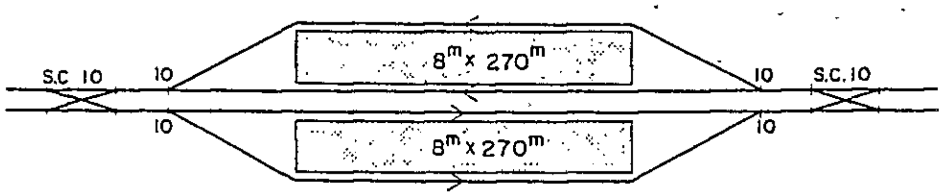


Fig. 5.2.8 Locations of Service Road and Water Courses

Gambir Station



Other Intermediate Stations

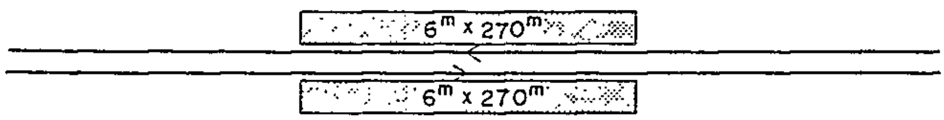


Fig. 5.2.9 Sketch of Track Layout at Stations with Elevated Tracks

Table 5.2.4 Problems in Alignment Planning

Place	Alternative A	Alternative B	Alternative C
Around the outlet of Jakarta Kota (The radius of curve of the existing line is of R = 225 m, and beginning point of the curve is close to a turnout.)	R = 225 m; same as that of existing line.	R = 215 m; less than that of existing line.	R = 210 m; less than that of existing line.
Sawah Besar Station	None	Because of continuation of single track operation with a part of existing line, it is necessary to provide equipment for passing by track for ground temporary tracks.	None
Area around Mesjid	None	A mosque is constructed to the east boundary of the railway land, a canal is located on the west side in this area, and there is no allowance in the land. Consequently, the elevated track structure should be constructed on the site of existing line, and accordingly, it is necessary to construct temporary tracks on the canal.	Same as Alternative B
Gambir Station	As a station front area of a width that is almost the same as that of the existing area is planned on the side (east side) of the existing station main building, it is necessary to construct the whole temporary tracks including station facilities for construction of the elevated track structure.	Same as Alternative A	Same as Alternative A
Cikini Station	None	Because of continuation of single track operation with a part of existing line, it is necessary to provide equipment for passing by track for ground temporary tracks.	None

(b) Profile planning

The element for decision of the track profile gradient is composed of the ground height, the surface height of crossing road, and the height of formation level decided by adding the girder height to secure the overhead clearance of 5.1 m. Besides, it is necessary to avoid competition of a transition curve with a vertical curve for securing safety of train running and ease of future maintenance. The longitudinal gradient is determined with these factors taken into account. The place in question is the section between Jakarta Kota Station and JL. Jayakarta. If competition between a transition curve and a vertical curve is avoided, the remaining length is of only about 570 m and connection cannot be made at 10 ‰ even when through girder bridge type is adopted for the JL. Jayakarta overroad bridge. Accordingly, it was determined to adopt 14 ‰, which is the steepest gradient used only in unavoidable cases. As a result, the overhead clearance is insufficient at JL. Mangga Dua which is located along the connecting gradient. Then, passage of small size cars is only allowed under this bridge having overhead clearance of 3.0 m, and that bridge is provided at a point that is shifted about 120 m toward the end point, and connection with this bridge is made by means of service road. On the other hand, 10 ‰ gradient can be used for connection on the end because there is no restriction.

Although it is desirable for reducing construction cost to make the height of the elevated track structure as low as possible and to avoid large span bridge for deciding the longitudinal alignment, crossing roads are located at 19 places in this section for track elevation, and planning was made to cross five roads within roads of particularly broad width with two spans each by providing piers in the central reserve of roads, as it is considered that these five roads permit construction of piers in the central reserve of road.

The required formation levels of main overroad bridges are shown in Table 5.2.5

(3) New Station Planning

The average distance between stations in the section between Jakarta Kota Station and Manggarai Station is of 2.4 km at the present.

A value around 1.0 km is desirable from the standpoint of convenience ot passengers as the distance between stations of urban railways. Consequently, it was decided to open new stations at five places based on the judgement of the traffic demand espected in the future and situations of the way-side areas. Accordingly, the average distance between stations is reduced to 1.2 km.

Locations where new stations will be opened are shown in Fig. 5.2.10.

Rough drawings of the horizontal and longitudinal alignment planned with the conditions of paragraphs (1) through (3) stated above are shown in Fig. 5.2.11.

Table 5.2.5 Required Formation Levels of Main Overroad Bridges

Road Name	Road Width (including expansion planning)	Span x number (kind of girder)		Required Formation Level (m)
*JL. Pangeran Jayakarta	33.0	20 x 2	(RC)	10.22
*JL. Mangga Besar	47.0	25 x 2	(PC)	12.05
*JL. Sawah Besar	47.0	39 x 2	(PC. Box)	13.81
JL. Pintu Air	4.2	12 x 1	(RC)	12.06
JL. H. Juanda	31.5	(23+17)	(PC+RC)	13.53
*JL. Monas Utara	30.6	(25+20+20+25)	(PC+RC)	14.38
*JL. Monas Selatan	32.6	19 x 2	(RC)	14.31
JL. Merdeka Selatan	20.1	30 x 1	(PC)	14.64
JL. Kebon Sirih	12.4	20 x 1	(RC)	13.84
JL. Wahid Hasyim	7.8	15 x 1	(RC)	13.98
JL. Cut Mutiah	13.2	(20+15+20+20+20)	(RC)	14.74
JL. Gondangdia Lama	8.8	34 x 1	(PC)	17.71
JL. Cikini	9.1	20 x 1	(RC)	17.58
JL. Diponegoro	15.8	22 x 1	(PC)	17.68

Note: *marks indicate places where piers are constructed in the central reserve of roads.

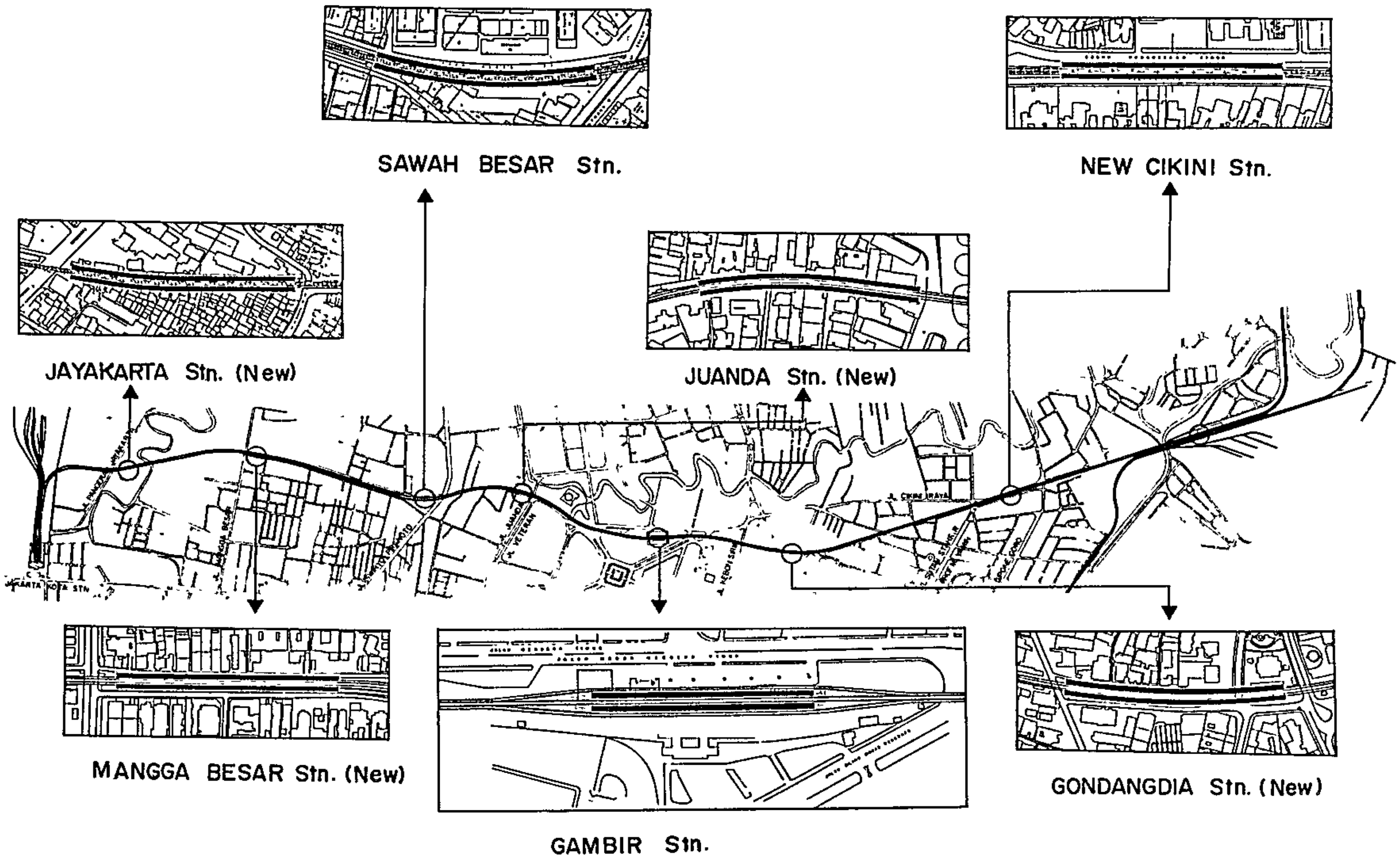


Fig. 5.2.10 Locations of Stations

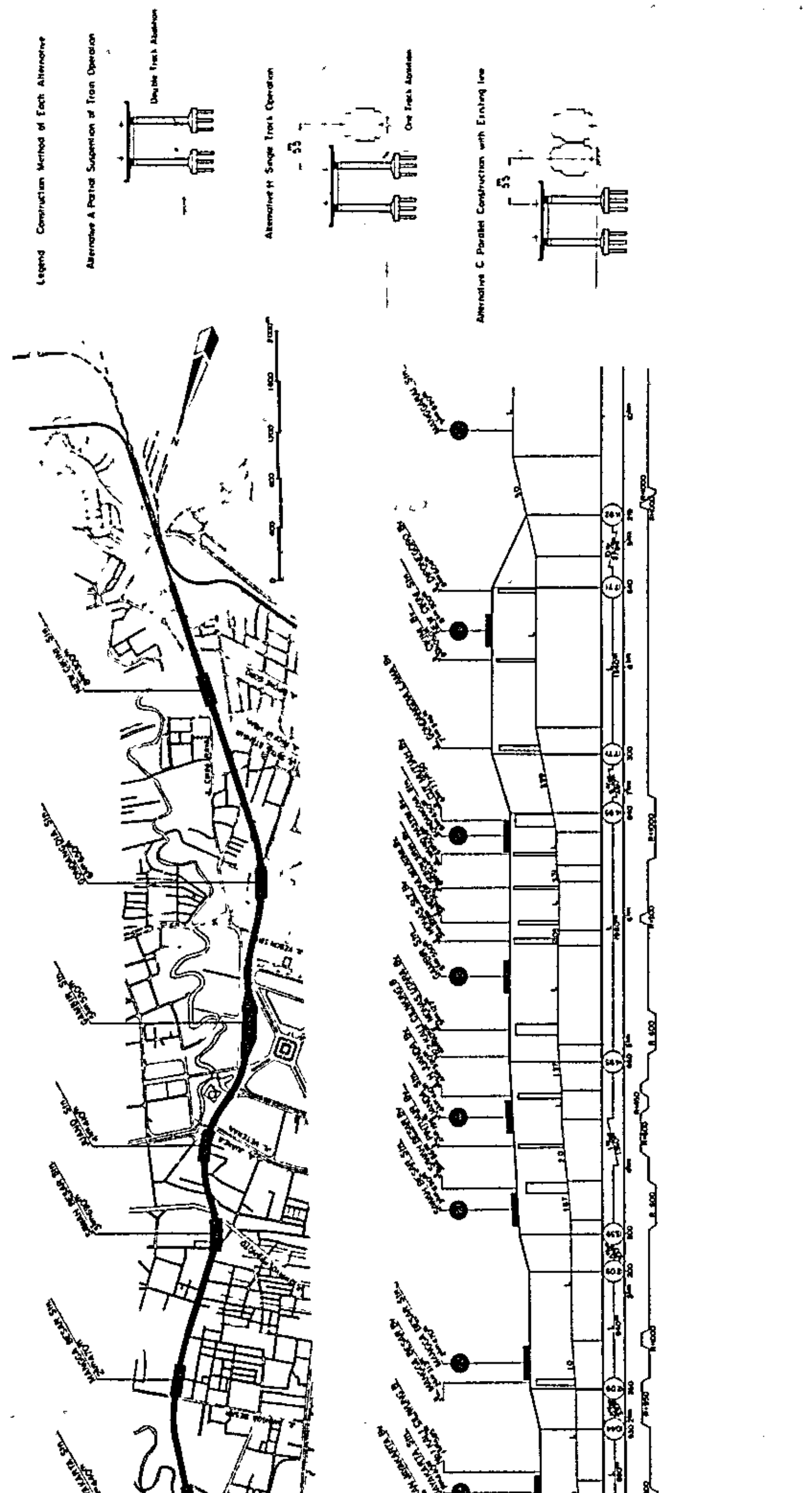


Fig. 5.2.11 Rough Drawings of Plan and Profile

5.2.4 Elevated Structure Planning

Following Elevated Structure Planning is based on the result of the Geological Survey in the Chapter 4.

Reinforced concrete structures was adopted for general sections and stations from the view point of utilization of the spaces under elevated tracks and of prevention of noise. Use of reinforced concrete girders is considered for overroad bridges of 20 m or less and use of prestressed concrete (PC) girders is considered for overroad bridges, and rigid frame abutments are considered as abutments.

The most economical beam slab type structure of 30 m (3 m + 8 m x 3 spans + 3 m) per block is adopted for structures in general sections, and Gerber type structure having 10 m girders within 3 x 10 m equal span in track direction is adopted for station sections from the aspects of vonvenience to passengers and utilization of space under elevated tracks. The connecting sections are of embankment with retaining wall type.

Girder bridges are adopted for the section around J1. Monas Utara and the area around J1. Cut Mutiah, which are considered to require provision of good scenery in particular.

The ranges in outline classified by the kind of construction are shown in Fig. 5.2.12, and skeletons of standard structure for elevated tracks, girder type bridge, overroad bridge, embankment with retaining walls and sectional views of stations are shown in Fig. 5.2.13 through Fig. 5.2.18.

5.2.5 Station Facilities Planning

(1) General

For planning of station facilities such as platforms, platform sheds, station main buildings and station front areas, the overall scale was planned with year 2000 as the target from the forecasted number of passengers in the future. The scale of station facilities was classified into three types, that is, large station, medium station and small station, and planning was made with factors such as configuration of train operation, result of situation of use of existing facilities, structural conditions (span assignment, overhead clearance) of structure for the station, planning for utilization of land and space under elevated tracks and so forth taken into account.

Large station: Gambir Station
Medium station : Sawah Besar Station, Cikini Station
Small station : Jayakarta Station, Mangga Besar Station, Juanda Station, Gondangdia Station

(2) Platforms

The existing platforms of the stations in the section where track elevation is to be made are platforms with the height of 430 mm or 180 mm. The height from the surface of platform to the surface of the floor in cars is as much as

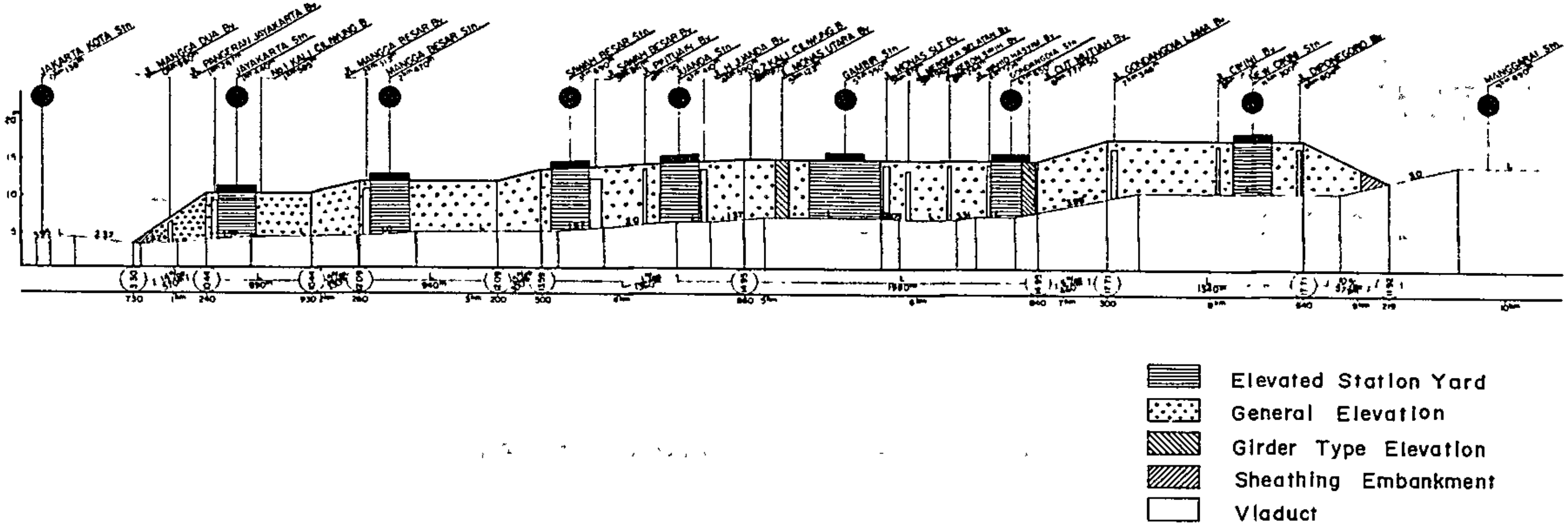


Fig. 5.2.12 Kinds of Structure for Elevated Tracks

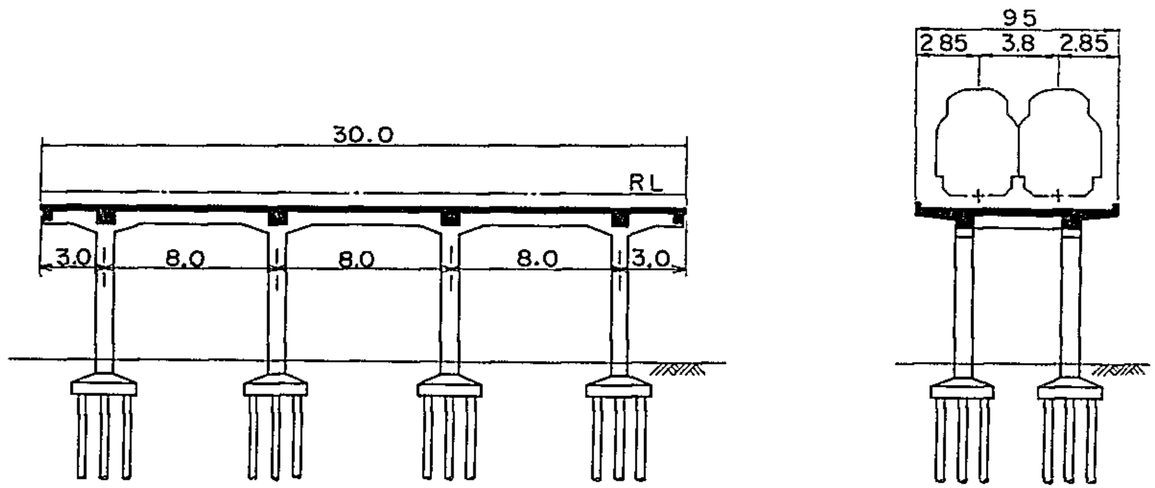


Fig. 5.2.13 Standard Structure for Elevated Tracks

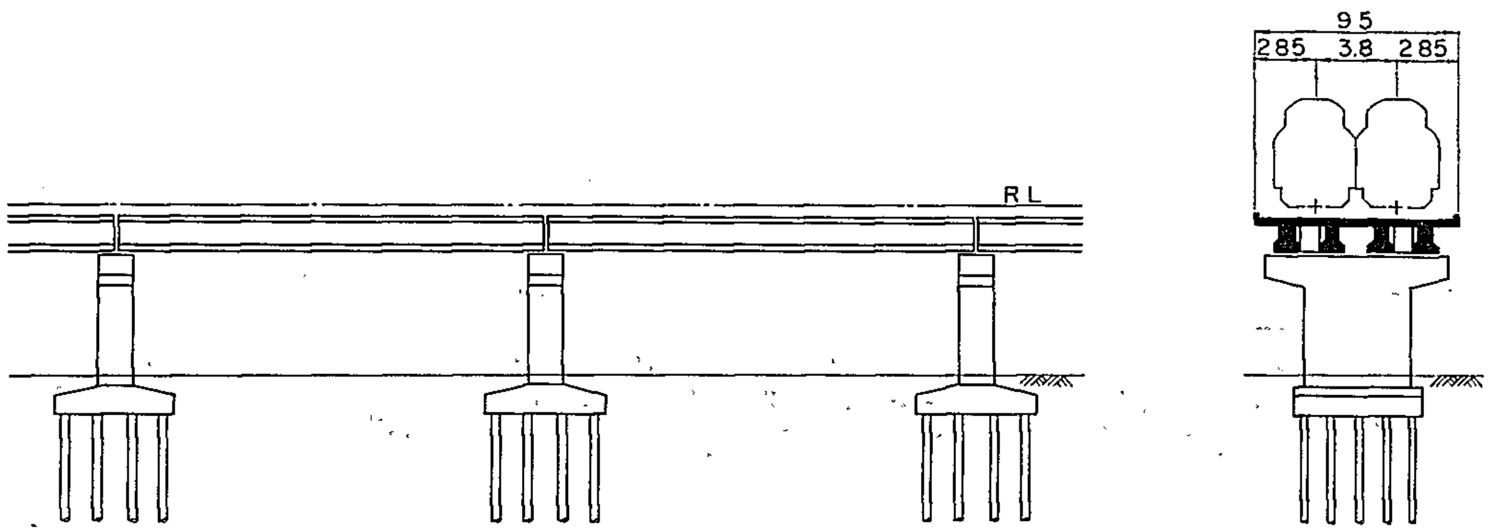


Fig. 5.2.14 Girder Bridges

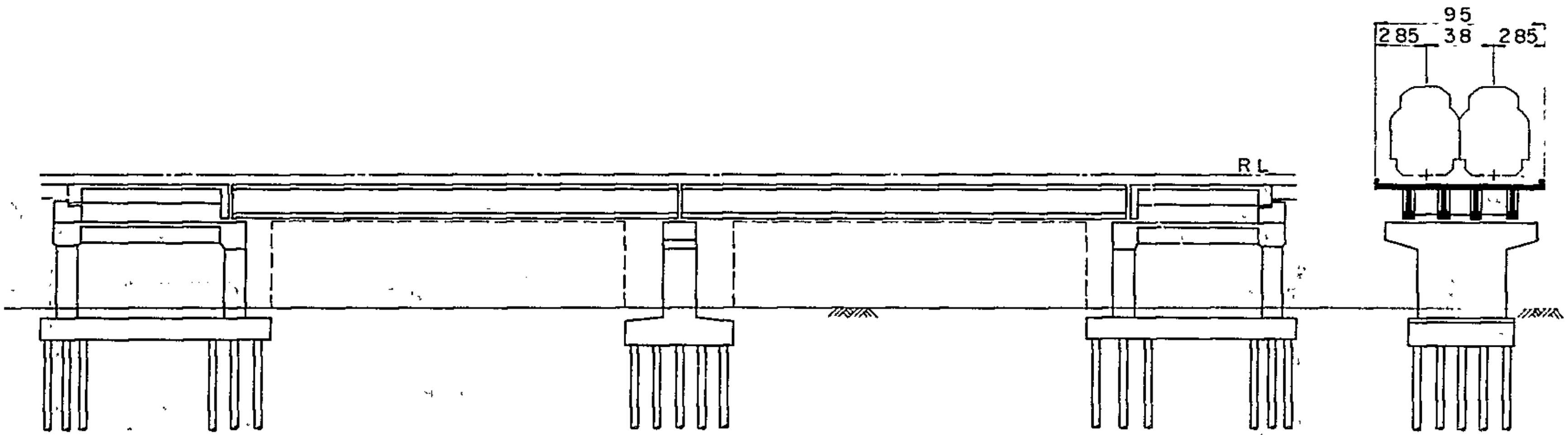


Fig. 5.2.15 Overroad Bridges

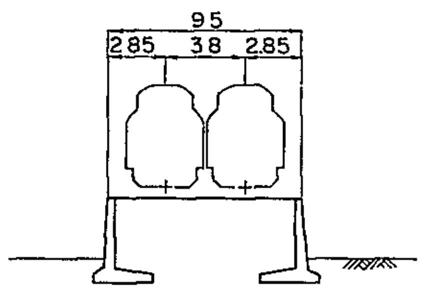


Fig. 5.2.16 Embankment with Retaining Walls

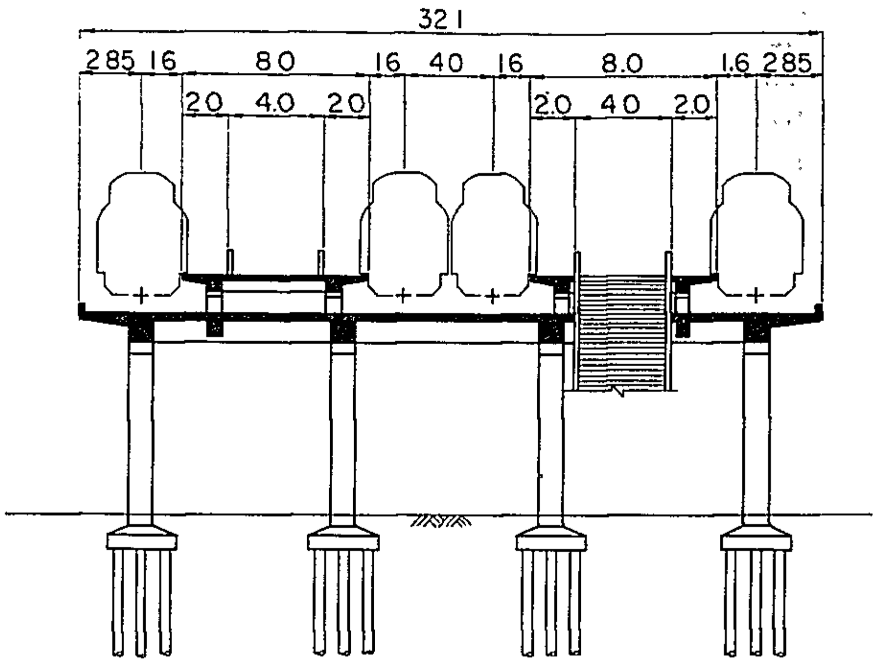


Fig. 5.2.17 Sectional View of Gambir Station

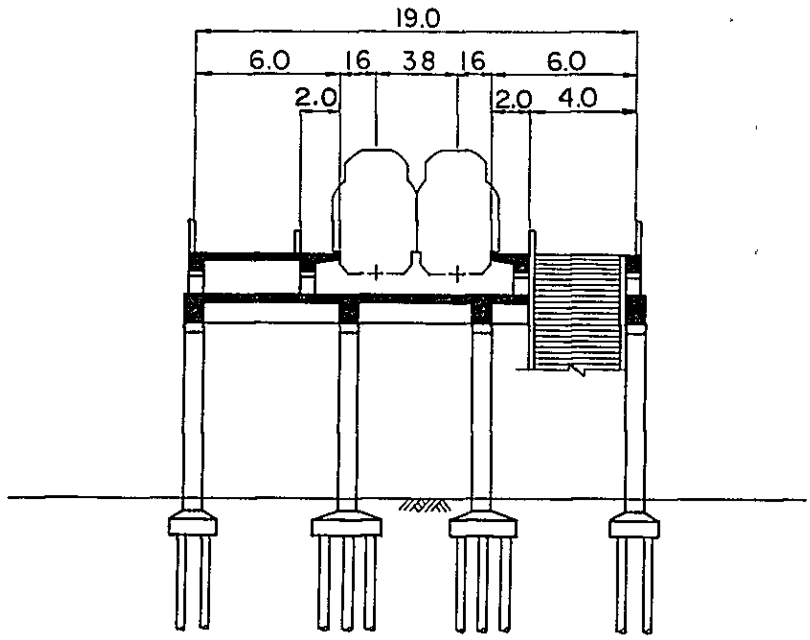


Fig. 5.2.18 Sectional View of Intermediate Stations

750 mm even at platforms with the height of 430 mm, and it is the present situation that one step each is provided both inside and outside of cars.

For planning platforms at elevated stations, the following problems of existing platforms were taken into account;

- Because of differences in levels between the surface of platforms and floors of cars, boarding and detraining are inconvenient, and much time is required.
- Because of the fact that much time is required for boarding and detraining, operating intervals of train become long and it is hard to cope with increase of passengers in the future.
- Very dangerous because of such a form that cars are overhanged on platforms.

In order to eliminate these problems, high level platforms are adopted in this plan like in the Master Plan, and the platform height of 950 mm from the surface of rail and distance of the center of track D = 1,600 mm. Although it is desirable that the platforms are level with the surface of floors of cars, planning was made based on the assumption to keep the steps provided in the existing cars remaining unremoved, as major modification to cars is required for removing them. The present situation and planned section of a platform are shown in Fig. 5.2.19.

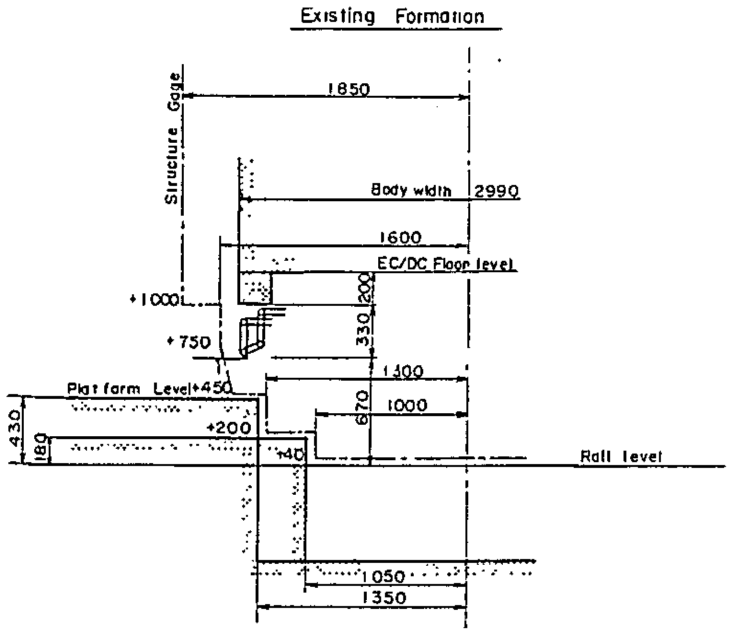
The platform width is determined by the number of boarding and detraining of passengers, but planning was made with island platforms of 8 m wide for Gambir Station and separate platforms of 6 m wide for other six intermediate stations with staircase widths and so forth taken into account. Platform extension of 270 m was planned to cope with departures and arrivals of trains of 12-coaches, which is the maximum train make-up determined in the operation planning.

(3) Platform Sheds

Planning was made to provide platform sheds over entire platform length for Gambir Station and half of platform length for intermediate station with services for passengers, weather conditions and so forth taken into account.

(4) Station Main Buildings

Station main buildings are points of contact between railway transportation facilities and passengers. Formation of spaces which permit smooth fluidization of passengers by connecting station front areas and platforms, and provisions of services which accompany travelling are main functions of station main buildings. They remain unchanged regardless of whether stations are located under the elevated structure or on the ground.



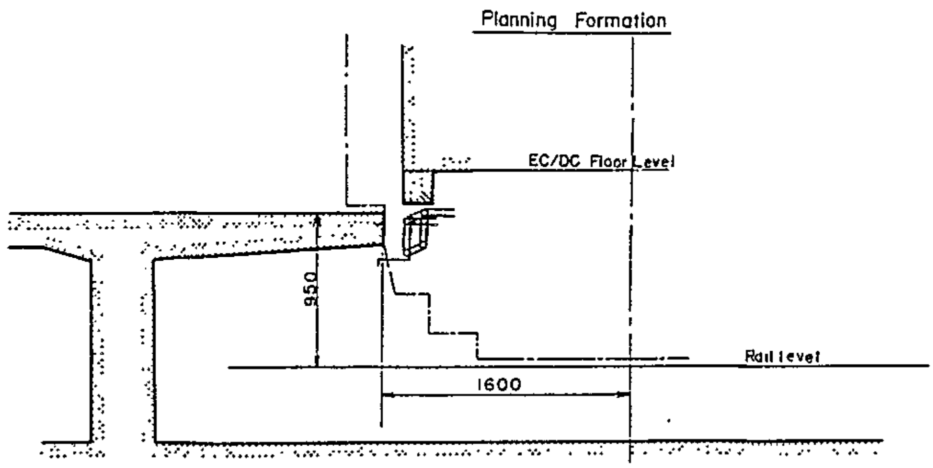


Fig. 5.2.19 Present and Planned Section of Platform

The following facilities are considered for each station main building;

- Fluidizing facilities: Concourse, passages, etc.
- Reception facilities : Wickets, fare adjustment office, etc.
- Service facilities : Waiting room, water closet, etc.
- Station operating facilities : Station master's room, office, resting lounge, etc.

The facilities scale of each station main building should be determined from the number of boarding and detraining passengers, number of station employees, handling of parcels and so forth, but 3,600 m^2 for large station, 1,800 m^2 for intermediate stations and 1,500 m^2 for small station are planned at this time.

The following factors were taken into account for decision of the facilities scale.

- The target year is 2000 A.D.
- Although ticketing is manually made for some time, it is assumed that automatic ticketing machines are introduced by the year of 2000.
- Handling of parcels at Gambir Station will be discontinued after completion of track elevation.
- Gambir Station and Sawah Besar Station can be used in two layers except for the concourse, and the spaces under the elevated tracks are effectively ŭtilized.
- To consider relationship with other plans for utilization of spaces under the elevated tracks, for stores, for instance.
- To expect the installation of escalaters in future.

An outline layout plan of facilities under the elevated tracks at a station is shown in Fig. 5.2.20 ∿ 21.

(5) Relevant Facilities Planning

The following facilities can be considered as main relevant facilities for a railway station.

(a) Facilities for passenger services

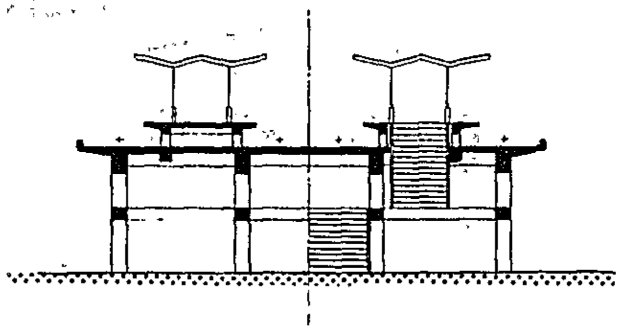
- Facilities for commercial such as retail stores and restaurants
- Facilities for individual services such as travel agency
- Facilities for public service such as post office

(b) Facilities which accompany station operation and relevant facilities

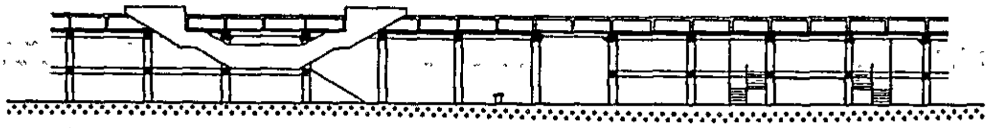
- Warehouse
- Parking area

These facilities are positioned so as to allow exhibition of terminal functions together with the station front area.

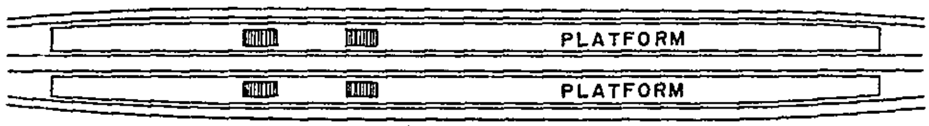
The layout of these facilities varies by the situation of the vicinity and the configuration of the station front area of each station, but it is desirable that they are consolidated as facilities which make use of the land and space under elevated tracks.



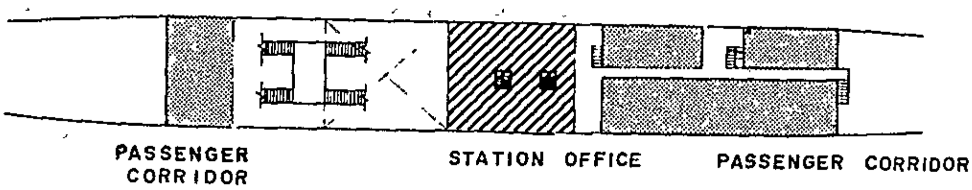
CROSS SECTION



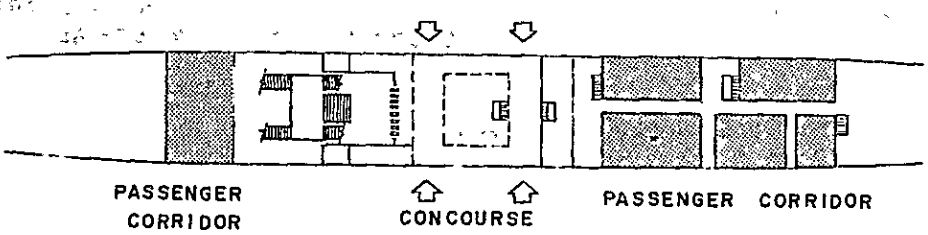
SIDE VIEW



(3) THIRD LEVEL PLAN

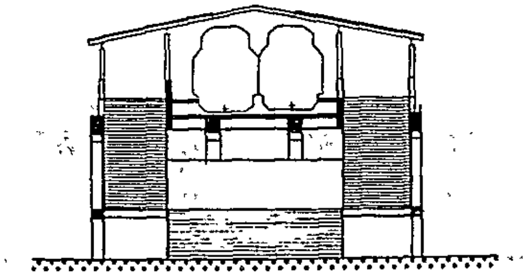


(2) SECOND LEVEL PLAN



(1) GROUND LEVEL PLAN

Fig. 5.2.20 Concept on Station Facilities Under Track Elevation
(Large Station)



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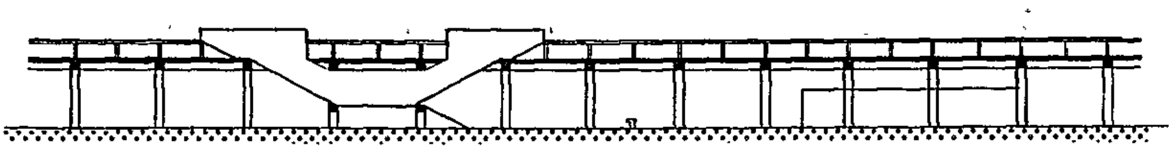
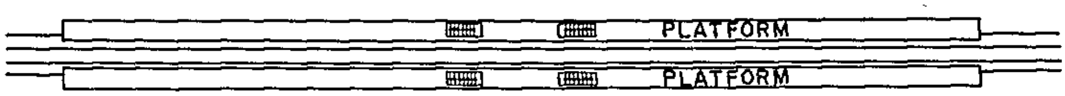
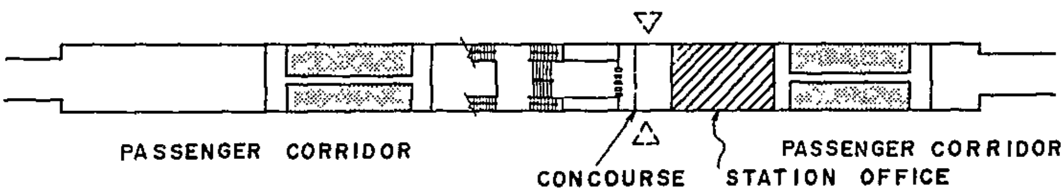


SIDE VIEW



(2) SECOND LEVEL PLAN



(1) GROUND LEVEL PLAN

Fig. 5.2.21 Concept on Station Facilities Under Track Elevation
(Intermediate Station)

5.3 Electrification Facilities

The electrification facilities between Jakarta Kota and Manggarai on the Central Line involve the following problems.

1) Almost all of overhead line facilities except contact wire are old ones initially installed and are in a bad state.
2) Gambir Substation has not enough capacity and needs addition of equipment.
3) Lighting facilities in stations are obsolete and the brightness is insufficient.
4) Protective function for the D.C. feeding circuit is not satisfactory. Interlinked circuit breaking device must be installed.
5) Outgoing line in Gambir Substation adopts T-type branch, which should be modified into π-type branch as soon as possible.
6) Maintenance of rail and rail bond, which are a return circuit, does not seem sufficient.
7) Dispatching system is weak and should be built up. Consolidation of dispatchers is needed to promote a big project like track elevation work.
8) In execution of track elevation work, settlement of the above problems should be kept in view.

5.3.1 Substation Facilities

Substation facilities shall be improved at the same time of track elevation work, in adjacent substations as well as in Gambir Substation which was newly constructed in accordance with the Intermediate Program. The reason is as follows:

1) It is the most suitable occasion for resolving the problems involved in the existing facilities.
2) Such facilities as can withstand increased transport capacity are needed, because the number of electric railcars and the number of operations can be augmented after completion of the elevated tracks.
3) As the trains will speed up upon completion of the elevated tracks, the rate of electric power consumption will increase.
4) Installation of new stations leads to increase of starting times of a train and thereby results in rise of electric power consumption.
5) Improvement of protective function is called for as preventive measures against grounding accidents during the construction period.

(1) Increase of Capacity of Substations

The capacity of substations was 1500 kW until the Intermediate Program. This poses no problem under the condition that 4-railcar electric trains are operated every 20 ~ 30 minutes. However, when the headway is shortened or when 8-railcar electric trains are operated, such capacity is insufficient. The Master Plan calls for 1500 kW x 2 units with allowance provided. As the traffic demand forecast in our study exceeds the estimate in the Master Plan, 8-railcar trains will have to be operated upon completion of the elevated tracks. Therefore, rectifiers shall be added in Gambir Substation. In parallel with the improvement of railway, the facilities of PLN should be built up.

It is desirable that the land space and PLN facilities should be planned to permit future expansion on the assumption that 12-railcar electric trains will be operated.

(2) Reinforcement of Protection for Feeding Circuit
Increased number of electric railcars, shorter headway, speed-up and installation of new stations lead all to increase of load on the feeding circuit, which tends to render protection troublesome. Therefore, the following countermeasures shall be taken.

1) At present, outgoing line of the feeding circuit in Gambir Substation is connected in T-type with the overhead line. For protection reason, this connection shall be changed to π-type one.
2) The feeding circuit shall be separated into two, one for Jakarta Kota and the other for Manggarai, and further divided into "up" line and "down" line.
3) Each feeding circuit shall be equipped with high speed circuit breaker for feeding circuit, which shall be made to match with the counterpart in adjacent substation and shall be linked together by interlinked circuit breaking device.
4) The feeding circuit shall be fully equipped with supervisory remote control so that dispatching system can be established to cope with change of system and actions against accidents.

(3) High-tension Circuit Device

Following the conversion to automatic signalling system, high-tension circuit device shall be installed in substations. Adequate attention shall be paid to the following points.

1) Highly reliable high-tension circuit device shall be adopted. Adjacent substations shall be assigned to the stand-by line against power failure in normal-service line substations and the device can permit automatic switching to the stand-by line.
2) Models of good performance shall be selected for circuit breaker and protective relay.
3) Monitoring and control shall be carried out at the dispatcher office through supervisory remote control.

(4) Facilities in Adjacent Substations

1) Jakarta Kota Substation
Construction of Jakarta Kota Substation is already planned by the Intermediate Program.
This substation is very important, because it is situated on the center of load where are concentrated many tracks, not only the Central Line but also the Eastern and Western Lines. The feeding circuit should be installed for specific line and specific operating direction and two high speed circuit breakers for feeding circuit match with those in Gambir Substation.
The protection for the feeding circuit must have the same function as that in Gambir Substation.
High-tension circuit device shall be connected to Gambir Substation.

As electric trains should be operated on a detour route during track elevation work, silicon rectifiers must be added. The related cost is included in the construction cost for detour operation.

2) Manggarai Sectioning Post

Old type circuit breakers in Manggarai Switch House shall be replaced by two high speed circuit breakers and the feeding circuit shall be protected in the same manner as for Gambir Substation.

Manggarai, which will become the center of load on the Central and Western Lines, is expected to call for construction of substation in consideration of further traffic increase in future. This is an important problem to be solved.

3) Jatinegara Substation

As Manggarai is a sectioning post, high-tension circuit device shall be installed in Jatinegara Substation.

This substation will be equipped with high-tension circuit device on the occasion of track addition to Depok on the Central Line and of electrification on the Bekasi Line. The design for Jatinegara Substation should be mindful of future conversion into total facilities.

(5) Precautions for Construction

1) Construction of viaduct and Gambir Substation

Adjacent to Gambir Substation is located PLN's Substation, which will come under the viaduct upon completion of new Gambir Station. Adequate attention should be paid to construction execution method for prevention of troubles.

It is desirable to acquire a land space around Gambir Substation in anticipation of future capacity increase.

2) Establishment of power dispatching system

There is a possibility of electric shock accident and grouding accident, because the period of track elevation work is long and the work will be executed near the existing overhead lines. In case of accident, many actions should be taken in a short time, such as elimination of causes, rescue of electric-shocked person, modification of train operation schedule and arrangements for restoration.

Establishment of power dispatching system is indispensable to such speedy actions.

3) Telecommunication circuit

Telecommunication circuit is necessary as circuit for supervisory remote control and interlinked circuit breaking between substations. A part of telecommunication circuit was to be provided within the framework of the Intermediate Program but has not yet been realized. Therefore, the telecommunication circuit should be designed in such a way that the required number of circuits can be constituted by completion of the Project.

4) Others

No matter which Alternative A, B or C for construction planning is to be adopted, substation facilities will show little difference. It is essential to place as soon as possible a purchase order for machines and equipments, of which manufacture requires much time.

5.3.2 Overhead Line Facilities

Overhead line facilities will be first hindered by track elevation work. For the parts under hindrance, countermeasures shall be taken such as removal, transfer and switch to temporary facilities.

(1) Precautions for Design

Overhead line facilities on the elevated tracks have no particular difference from those on the Western Line. However, the following points should be taken into consideration for execution of design.

1) As the facilities on the elevated tracks are high above the ground, weather conditions such as thunder and wind become severer. In Jakarta, it thunders very often and there is a high possibility of lightning strike. For protection against lightning, overhead ground wire and lightning arrester are necessary. Installation of the former shall take into account the protection angle and arresters of good performance recently developed shall be used.

   It is no exaggeration to say that whether or not overhead ground wire and lighting arrester can display their performances dependent on the condition of grounding. From the fact that the grounding resistance of the viaduct itself is low, the effect of grounding can be even more enhanced if the grounding electrode is linked with buried ground wire connected to welded reinforcing bars.

2) Elevated tracks, without any level crossing and without any interference by livestock, permit speed-up up to the limit of rolling stock performance.

   Therefore, the overhead line should always keep good characteristics. An overhead line capable of withstanding high speed train operation is realized by fine adjustment. Facilities easy to adjust and with less functional change shall be designed. Maintenance staff should be trained to upgrade their skill.

3) Facilities on the elevated track are so conspicuous as to spoil the beauty of the city. It is desirable to take this point into account for designing.

4) Construction work calls for safety protection for workers and existing facilities. Care for work safety should be taken in planning and designing of facilities.

(2) Precautions for Works

1) With Alternative A, a temporary station shall be constructed and overhead line shall be temporarily installed for shuttling operation at Gambir Station. Although his overhead line is to be removed upon completion of construction, its function must be at the same level as permanent facilities.

2) With Alternative B, single track operation shall be continued during construction period and with Alternative C, the elevated tracks shall be constructed while double track operation is continued. In consequence, existing overhead lines should be removed and transferred.
On such occasion, preventive measures against electric shock and grounding accidents are important.

3) In Alternative A, B or C without exception, attention should be paid to work progress control and changeover work sequence to permanent facilities upon completion of construction. Adequate coordination is necessary for construction control, because rail lay-down will coincide with overhead line installation toward completion and both works will be executed simultaneously on the occasion of changeover to permanent facilities.

5.3.3 Lighting Power Facilities

Main work for lighting power facilities is new installation of station facilities and high-tension distribution lines for automatic signalling system.

(1) Station Facilities

The stations to be equipped with facilities are a big Gambir Station and other 6 stations; Jayakarta, Mangga Besar, Sawah Besar, Juanda, Gondangdia and Cikini.
Main facilities are lighting power sources and lighting equipments. Adequate lighting facilities are necessary at ticket windows and ticket gates for the reason of service execution. As station facilities will be totally renewed, it is to be desired that facilities convenient for passengers, such as, apart from announcement equipments and electric clocks, electric information boards, direction-guide equipments and front-of-station lightings, should be adopted to ensure formation of a station worthy of gateway to the city.
Gambir Station will be installed with signalling and telecommunication machine room and signal cabin. Electric power for these facilities shall be supplied by high-tension distribution lines for automatic signalling system in view of maintenance of high reliability.

(2) High-tension Distribution Line

Following the conversion to automatic signalling system, electric power must be supplied to signalling equipments to be installed between stations.
Less frequent power failure and inexistence of phase difference are required for power source for signalling equipments using track circuit. Therefore, electric power for automatic signalling system can not be supplied from PLN's low-tension power source near the track.
In consequence, special high-tension distribution lines will have to be newly installed on the section of automatic signalling. As power failure is never allowed for this high-tension distribution lines during the time zone of train operation, Jakarta Kota, Gambir and Jatinegara Substations shall be linked with one another and power source

will be automatically switched over to adjacent substation in case of power failure in normal-service line substation.

It is desirable to install the distribution lines by cable on the elevated section where weather conditions such as thunder and wind are severe. In case of aerial cable, overhead ground wire and lightning arrester shall be provided.

(3) Precautions for Works

1) If Alternative A is adopted, a temporary station for shuttling operation will be constructed at Gambir Station. Although lighting power facilities to be installed at the temporary station are temporary ones, conception for capacity and insulation must be the same as that for permanent facilities.
2) As track elevation work involves a danger, it is important to execute adequate protection for wiring and to supervise it so as not to suffer obstruction from the surroundings.
3) Alternatives A, B and C call for temporary construction of stations and transfer of obstructive articles. Lighting power works require appropriate work progress control, coordination and preparation for works to be executed simultaneously with installation and removal of buildings and equipments.

5.3.4 Improvement of Electrification Facilities due to Detour Train Operation

Transport capacity on the Central Line will be lower because of partial suspension of train operation in Alternative A and single track train operation in Alternative B. To make up for weakened transport capacity, electric trains should be operated through detour route via the Eastern or Western Line.

However, conversion to automatic signalling system has not yet been done either on the Eastern Line or on the Western Line. Such conversion, a big work involving new installation of relay interlocking device at stations, will be difficult to execute at once and therefore detour train operation will have to be based on actual signalling protection system. Consequently, the headway can not be shortened and transport capacity must be secured by increased number of train railcars.

As mentioned earlier, only 4-railcar electric trains can be operated on the electrified sections and on the Western Line of which electrification is planned, and it is impossible to operate trains made up by more than 6 railcars.

The number of motor cars is related with the capacity of electrification facilities. It is four in case of 6 ~ 8 railcar electric trains and six in case of 10 ~ 12 railcar electric trains. The followings are improvements of facilities necessary to operation of 8-railcar trains which is required for the time being.

1) The minimum capacity of substation depends on the maximum feeding current from substation.

   A big current runs, though instantaneously, due to overlapped starting current when electric power is supplied to numerous loads of electric trains like during commuting hours. Ordinary minimum requirements are the capacity of rectifier which can withstand this instantaneous current. In addition, future increase of load and aspects of manufacture and utilization must be taken into consideration in view of determination of a capacity with allowance provided. For operation of 8-railcar electric trains, two or more units of 3000 kW rectifier should be installed.

2) In response to addition of rectifiers, PLN power facilities should also be strengthened.

3) D.C. high-speed circuit breaker shall be used for interrupting the load of electric trains.

   The bigger the capacity of rectifier and the shorter the distance between substations, the larger will become the fault current.

   High-speed circuit breaker with sufficient interrupting capacity should be used to ensure perfect interruption against any type of fault.

4) As the feeding current increases, the setting of relay rises and thereby it becomes little by little difficult to distinguish the fault current from the load current. Interlinked circuit breaking device must be adopted together with ΔI-type relay.

5) The scope of facilities improvement is limited to the sections where 8-railcar electric trains will be operated. Nevertheless, it is desirable that all the electrified sections should be improved for relief of restrictions on utilization of electric cars.

6) Increase of load current gives rise to larger voltage drop within the feeding circuit and operation of electric trains becomes impossible if the voltage is lower than the specified overhead line voltage. Such a possibility occurs between Manggarai and Bogor on the Central Line but there is no problem with the Manggarai ~ Depok section where track addition and electrification works on the Central Line will be executed under a separate program. Addition of feeders will be necessary on two sections; the Depok ~ Bojonggedeh section and the Bogor Substation ~ Bogor Station section.

7) As to the section from Anchor to Tanjungpriuk, it is desirable to make detailed examination upon study of train operation needs and of actual conditions of feeding circuit.

8) Many problems will be further imposed on operation of 12-railcar electric trains. In such a case, radical improvement of facilities will be necessary.

A substantial amount of construction cost is needed for execution of the above countermeasures. But the import of facilities improvement is nothing but tells you advance execution of a part of projects shown in the Master Plan. The study team suggests that this problem relevant to detour transport should be also examined for track elevation work.

5.4 Signalling and Telecommunication Systems Improvement Planning

As described in Section 5.1.6, it is scheduled that level crossing protection facilities and telecommunication system between Jakarta Kota and Manggarai Station of the Central Line will be modernized by 1983 under the Intermediate Program. For planning improvement of the signalling and telecommunication system accompanying track elevation work, therefore, it is based on the precondition that related projects of the Intermediate Program are executed as scheduled and it is also necessary to consider concert with the Master Plan of JABOTABEK Area Railway Transportation Improvement Program.

5.4.1 Signalling System

The signalling system is a very important system for securing safety of transportation and also for improving the transportation efficiency. The existing system, however, cannot necessarily said to satisfy the mission of railways, that is, safe, punctual and rapid, as it is a mechanical signalling system and its deterioration is conspicuous. It is therefore necessary to carry out modernization of the signalling system with the following points taken into account.

a) Improvement of degree of safety
b) Rationalization through ease of handling and maintenance of the facilities
c) Adaptability to high speed and high density train operation

In order to satisfy the basic conception stated above, it is wanted to introduce such an electrical signalling system that is shown in Fig. 5.4.1. The outline of main components of this system is described below.

(1) Automatic Block System

The automatic block system is such a system that blocking and signal indication are automatically controlled by the movement of train running on continuous track circuits provided in block sections. This system is far safer compared with the existing system, and it is possible to easily increase the number of block sections with signals additionally built between stations. Therefore, it is a system that is matched with high density operation.
However, the number of block sections and the location of signals should be determined with conditions such as train operation, tracks and visibility of signals.

(2) Signal Equipment

The following signal equipment will be installed in the elevated section as matched with the train operating conditions.

1) Block signals will be installed, as shown in Fig. 5.4.2, at boundaries of block sections for the purpose of efficiently controlling trains running between stations. Signal indication is automatically controlled by advancement of the train, and three aspects, i.e., green (proceed), yellow (caution) and red (stop), are the basic.

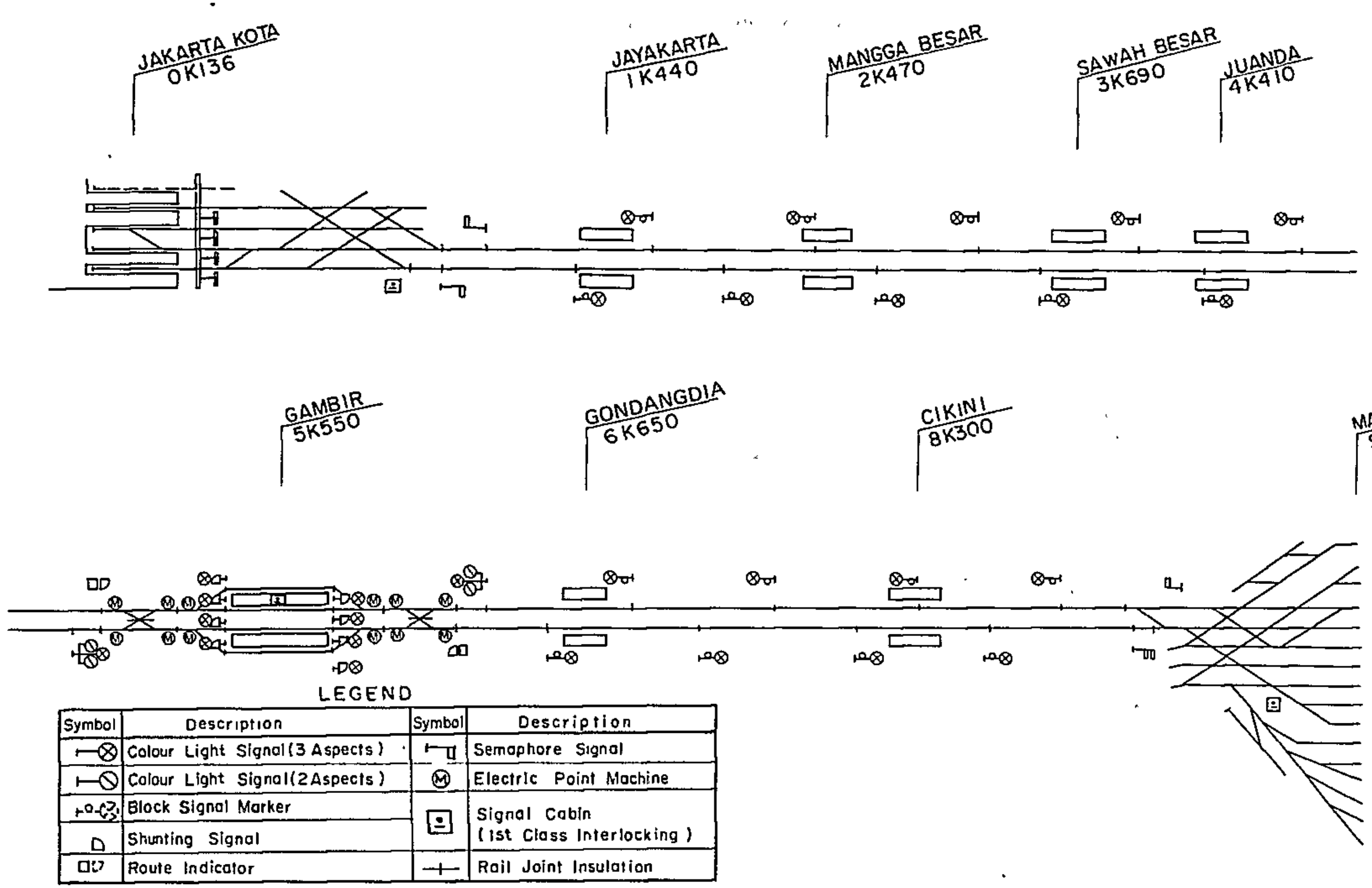


Fig. 5.4.1 Configuration of Signalling System

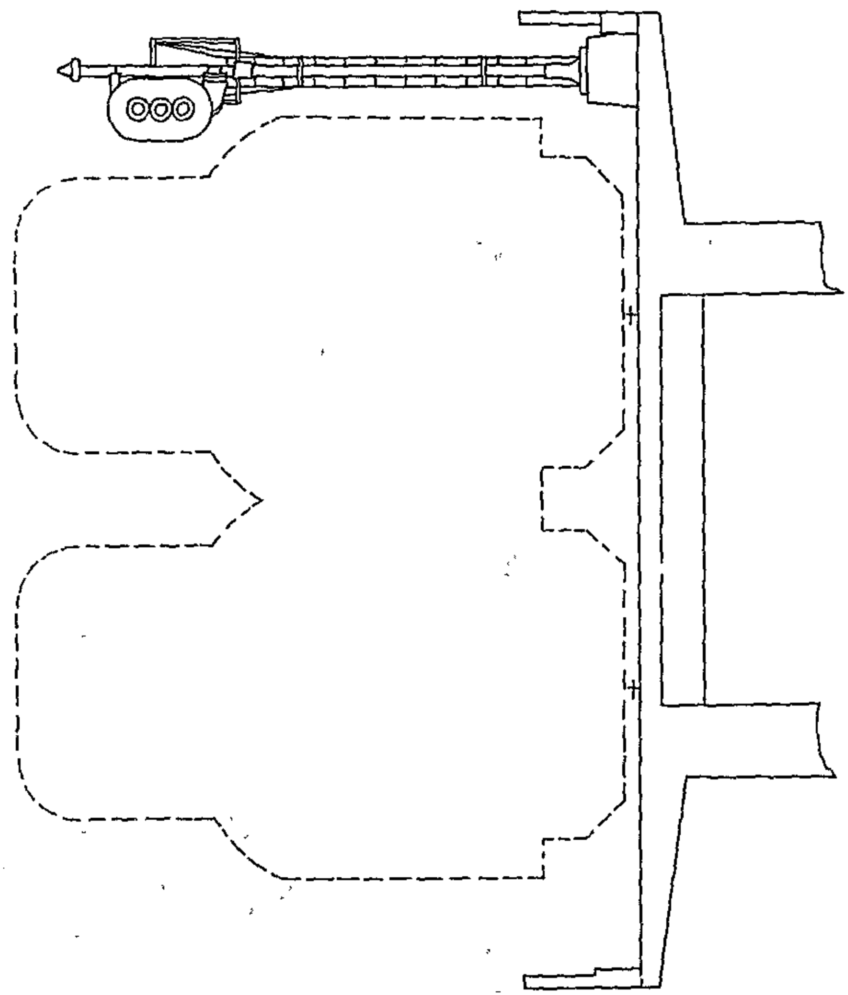


Fig. 5.4.2 Block Signal

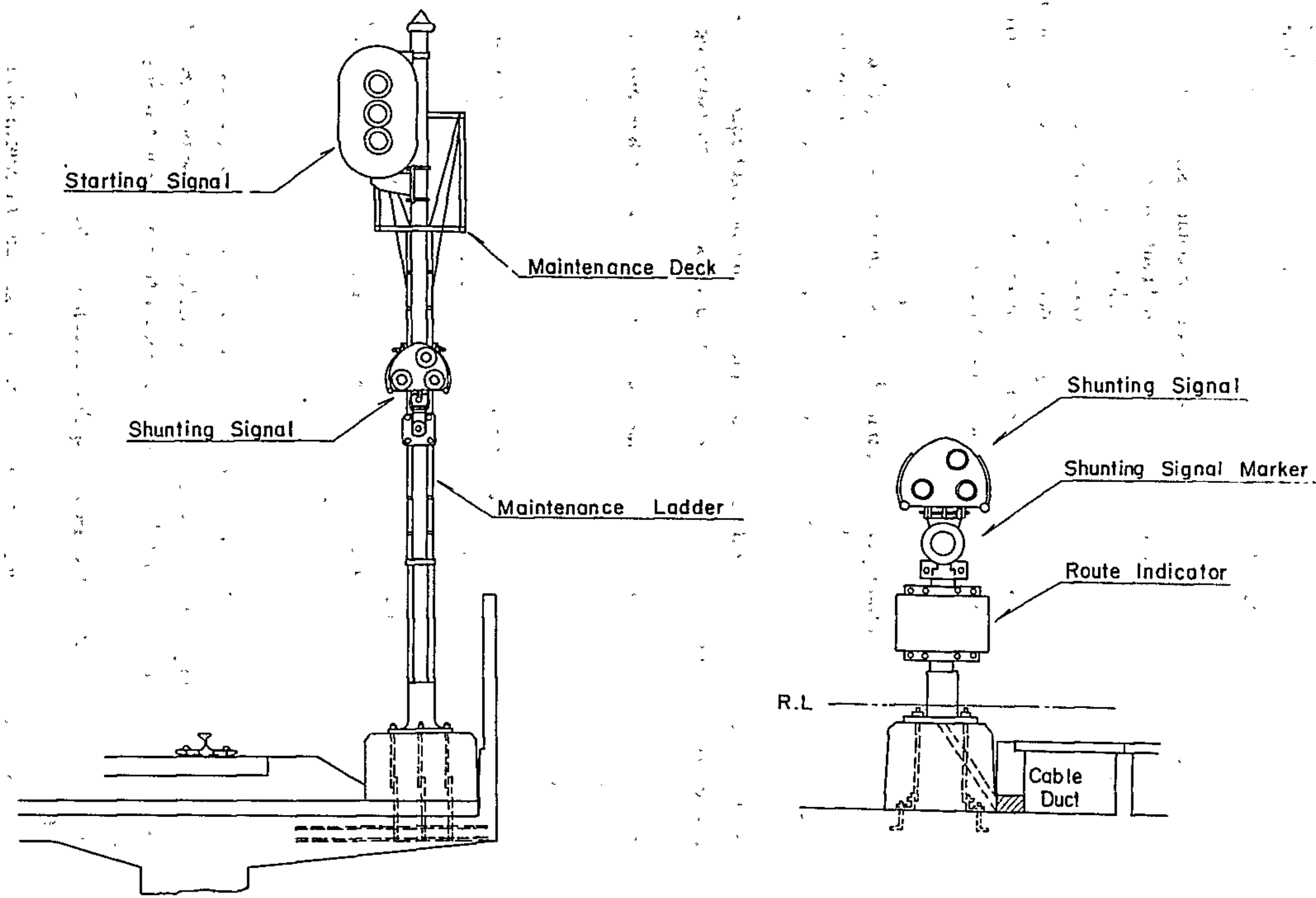


Fig. 5.4.3 Signal Equipment

2) Home signals will be installed at the entrances to the yard of Gambir Station, and departure tracks will be equipped with starting signals as shown in Fig. 5.4.3. These signals are semi-automatic signals, the indication of which is automatically controlled in accordance with advancement of trains like block signals described in the preceding paragraph, and which also permit manual control by signal operators.
3) Shunting signals shown in Fig. 5.4.3 will be installed in Gambir Station for efficiently controlling railcar shunting operation, and route indicators which display shunting tracks as required will also be installed.
On the other hand, the home signals and starting signals located at entrances to the yards of Jakarta Kota Station and Manggarai Station will be kept as mechanical signals. Accordingly, it is necessary to improve them in order to establish concert with the automatic block system for the elevated section.

(3) Track Circuit

Track circuits are essential equipment as train detectors in an automatic signalling system. A track circuit is of such a system that presence of a train is detected by the electric circuit composed of right and left rails so as to be shunted by axles of the train.
As the elevated selection is a D.C. electrification section, commercial frequency track circuits which are the simplest and the most economical track circuits providing high reliability will be provided.
Rail insulators will be fitted at the boundaries and impedance bonds will be provided in order not to block traction current.

(4) Point Machine

The density of train operation at Gambir Station will be extremely increased in the future and throwing of point machines will become frequency as a result. Therefore, it is necessary to shorten the switching time through introduction of electric point machines. As interlocking relationship can be easily established between electric point machines and signals and among point machines, it is possible to improve the degree of safety.

(5) Interlocking Device

An interlocking device will be installed to ensure the train operation at Gambir Station to be equipped with many signals and point machines, because there are multiple train entry routes and shunting operation will also be performed at this station.
It is desirable to install a relay interlocking device because of the reasons stated below.
1) It is composed of relay logic circuits providing fail-safe function which always causes operation of interlocking relation of signals, point machines and so forth to the safety side, and it provides high reliability.

2) It is possible to cope with train operation at high density because route setting can be quickly made.
3) Operation is easy, and operation errors by signal operators rarely occur.
4) Modification is easy in correspondence to changes to rail alignment in the yard.

(6) Automatic Train Stop Device

Safety of train operation is secured with the automatic signalling system through introduction of automatic signals, electric point machines and relay interlocking devices. Therefore, trains are safety as long as they are operated in accordance with indication of signals. Once indication of signals, however, is ignored due to acute sickness or carelessness of a train operator, there is a possbility of occurrence of a serious accident such as collision and derailment.
In the section in which train operation is of high density, therefore, it is desirable that automatic train stop devices providing such functions that an alarm rings when a train approaches a stop signal and the train is automatically caused to stop if the operator fails to take braking action within the specified length of time are provided.

5.4.2 Telecommunication System

The telecommunication system permits on-schedule operation of trains in the railway transportation system requiring higher speeds and higher density, and promptly makes exact correspondence to unexpected situations such as an accident. Accordingly, it increases safety of transportation, improves services to passengers and makes contribution to improvement of efficiency of railway management.

The telecommunication system to be provided under this project should be in concert with the railway telecommunication system in JABOTABEK Area in correspondence to the Master Plan. Therefore, it will be the same as the telecommunication system planned in the Intermediate Program as shown in Fig. 5.4.4.
The outline of main system components is described below:

(1) Telecommunication Cable
The telecommunication cables will be of 50 pairs for accommodation of PABX tie lines, dispatching telephone lines and many other important lines. The cables are composed of star twinning for unit cables in 5 quads. Cables will be installed in exclusive cable duct in the elevated section.

(2) PCM Cable Carrier Equipment
Accompanying expansion of data transmission lines, PCM cable carrier equipment which are hardly affected by induced noise distortion and are suitable for high speed data circuits will be installed for making data transmission of higher quality.
The PCM cable carrier equipment are compact and economical compared with conventional cable carrier equipment.

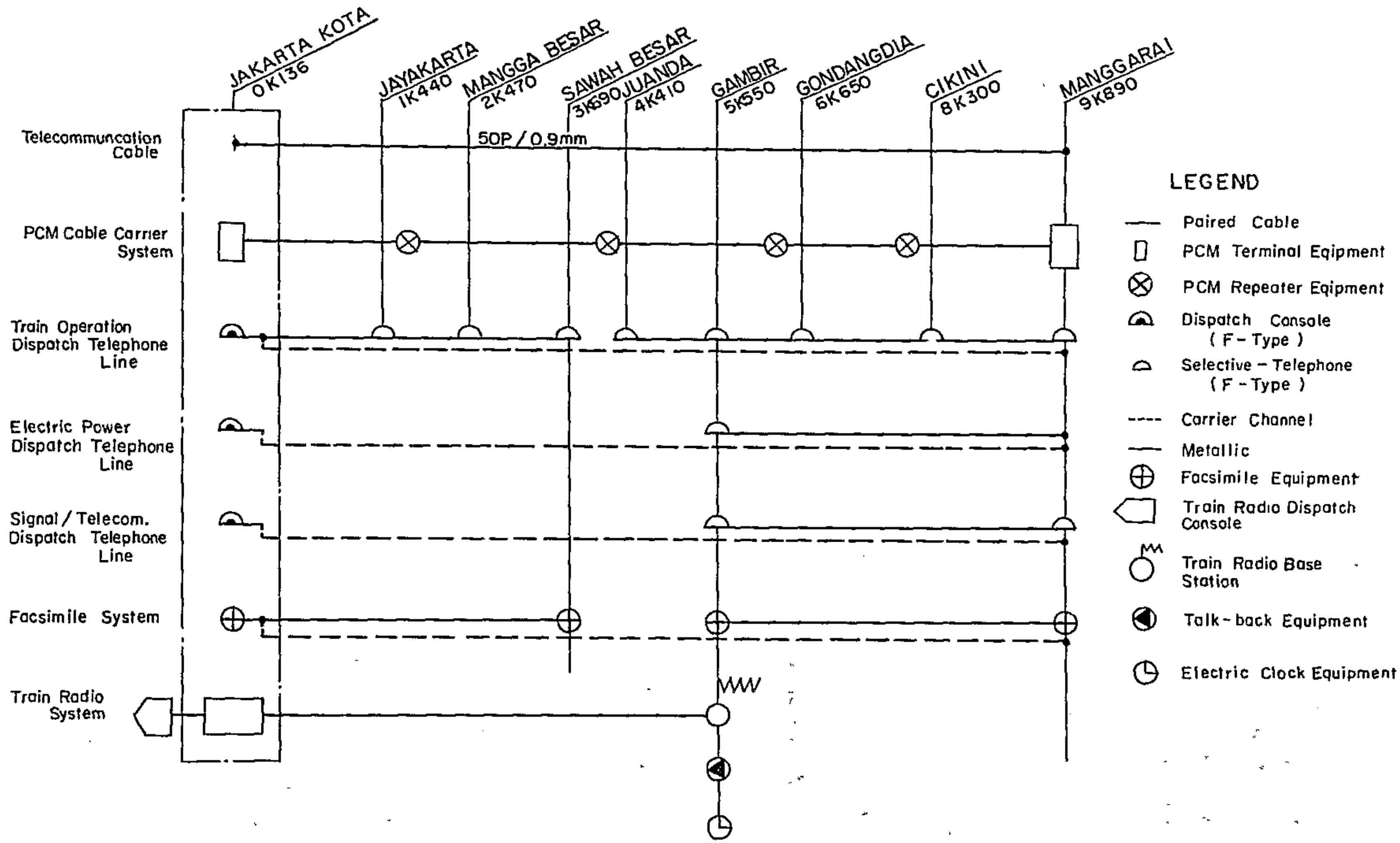


Fig. 5.4.4 Configuration of Telecommunication System

(3) Dispatch Telephone System

The dispatch telephone system permits the dispatch center to call all stations individually or collectively.

Frequency discrimination system is desirable as the method of calling as viewed from the calling time and speech quality.

(4) Facsimile Equipment

The facsimile equipment permits transmission and receiving of train operation data, general station management data and so forth in the form of characters, figures and graphs.

The facsimile equipment to be provided under the Intermediate Program will be reused for this project.

(5) Train Radio Equipment

Train radio equipment will be provided for transmission of operation and dispatch information and for emergency communication between the crew in running trains and the train dispatch center on occurrence of accidents.

The plan for provision of train radio equipment under the Intermediate Program is pending, but the train radio equipment will be same as what were planned in the original Intermediate Program with increase of traffic and zone composition in the future taken into account.

(6) Talk-back Equipment

1) At Gambir Station where a relay interlocking device will be installed, the talk-back equipment will be used for making mutual communication between signalmen and switchingmen for carrying out efficiently field works such as route composition, railcar coupling and uncoupling works during shunting operation and maintenance works for signal equipment installed on the field. The master device will be mounted on the control panel in the signal cabin, and speakers will be mounted near shunting signals and electric point machines.

2) A broad-casting equipment will also be installed at each station for station broad-casting to release information to passengers. The master device will be installed in the train operation room; and speakers will be mounted at platforms.

(7) Electric Clock Equipment

It is desirable that an electric clock equipment is installed at Gambir Station for improving passenger service because this station will serve for many passengers in the future.

The electric clock equipment is such a system that multiple sub clocks are operated through D.C. pulses from a single master clock, and all sub clocks accurately operate with the accuracy that is same as that of the master clock.

5.4.3 Considerations on Execution of Signalling and Telecommunication System Installation Works by Alternatives

Three alternatives have been considered as already described for execution of construction work of this project. For execution of signalling and telecommunication system installation work, it is necessary with each one of these alternatives that execution is made by the facilities department in advance regarding construction of signal cabin, operator rooms and rooms for signalling and telecommunication equipment, installation of rail insulators and provision of cable ducts in the elevated section.
Precautions are described below for each one of three alternatives.

(1) Alternative A: Partial Suspension of Train Operation
This plan firstly requires the suspension of train operation between Jakarta Kota and Gambir Station due to construction of elevated track structure in this section, and then the execution of construction between Gambir and Manggarai Station follows under the same condition described above after the completion of construction of the former section. The feature of this alternative is that the length of time required for construction work is the longest, while the construction cost of signalling and telecommunication works is the lowest.
This alternative requires the following relevant works for execution of signalling and telecommunication system installation work.

a) Temporary work for coping with shuttling equipment work at Gambir Station.
b) Temporary installation of facilities for blocking operation at Rajawali Station on the Eastern Line and Dukuh Station on the Western Line to cope with detour train operation.

It is necessary to consider the following matters in particular in each section.

1) Between Jakarta Kota and Gambir Station; and between Gambir and Manggarai Station
Withdrawal of existing signalling facilities and level crossing protection facilities may be made during the period of track elevation work, but telecommunication facilities should be withdrawn after commencement of train operation in each section on completion of installation work of new facilities.

2) Gambir Station
It is necessary to construct temporary signal cabin and operation room before commencement of construction of shuttling equipment by the track and civil engineering departments, and then to install temporary block instrument, interlocking device, signal levers and telephone in them to cope with shuttled train operation and also for operation during changeover works to temporary facilities.

3) Rajawali Station and Dukuh Station
It is necessary to construct signal cabins before commencement of partial suspension of train operation of the Central Line for track elevation work, and to install block instruments, signal equipment and telephone.

(2) Alternative B : Single Track Operation

This alternative is to continue train operation between Jakarta Kota Station and Manggarai Station on single track during the period of construction of elevated track structure to secure the traffic demand. Like double track operation (Alternative C), the period of time required for construction work is shorter than that of partial suspension of train operation (Alternative A), but the construction cost of signalling and telecommunication works is the highest among three alternatives. This alternative requires the following relevant works for execution of signalling and telecommunication system installation work.

a) Temporary installation of facilities for blocking operation and interlocking devices at Sawah Besar Station and Cikini Station and temporary installation of facilities for blocking operation at Dukuh Station on the Western Line and Rajawali Station on the Eastern Line before commencement of track elevation work in order to cope with single track operation and detour operation during the construction period.

b) Modification to level crossing protection facilities before commencement of track elevation work to cope with single track operation during the construction period.

c) Prior removal of signalling and telecommunication facilities which cause obstruction to execution of track and civil engineering works.

d) Temporary work to cope with single track equipment work at Gambir Station.

In concrete, it is necessary to take the following matters into account for execution of work in each section.

1) Between Jakarta Kota and Gambir; and between Gambir and Manggarai
   a) It is necessary to construct signal cabin at Sawah Besar Station and Cikini Station before commencement of work for construction of passing equipment, and then to install temporary block instruments, interlocking devices, signal levers, signal wires, point machines, telephone, etc. to cope with single track operation during the period of track elevation work.
   b) It is necessary to carry out modification to AF track circuits and to relay logic circuits of control units out of level crossing facilities, before commencement of single track operation accompanying track elevation work.
   c) It is necessary to remove in advance the level crossing protection facilities, block signals, signal wires, telecommunication cables, PCM repeaters, etc. which cause hindrance to the track elevation work.

2) Gambir Station

The precautions for execution of work at Gambir Station are same as those of paragraph (1) 2) of Section 5.4.3, that is, to carry out the work of temporary installation of signalling and telecommunication equipment before commencement of temporary track work by track and civil engineering departments.

3) Rajawali Station and Dukuh Station

The precautions for execution of work at Rajawali Station and Dukuh Station are same as those of paragraph (1) 3) of Section 5.4.3, that is, to carry out the work of temporary installation of signalling and telecommunication equipment before commencement of single track operation.
When this alternative is selected, withdrawal of existing signalling and telecommunication facilities is made after commencement of train operation on elevated tracks on completion of track elevation work in the entire section.

(3) Alternative C : Double Track Operation

This alternative is to continue double track operation of trains between Jakarta Kota and Manggarai to secure the traffic demand even during the period of track elevation work. When this alternative is compared with single track operation (Alternative B), the construction cost of signalling and telecommunication works is lower, although the time of completion of work is the same.
This alternative requires the following relevant works for execution of signalling and telecommunication system installation works.

a) Temporary installation of facilities to cope with temporary track construction work at Gambir Station.
b) Prior removal of signalling and telecommunication facilities which cause hindrance to execution of track and civil engineering work.

In concrete, it is necessary to take the following matters into account for execution of work in each section.

1) Between Jakarta Kota and Gambir; and between Gambir and Manggarai
   a) It is necessary to remove in advance the level crossing protection facilities, block signals, signal wires, telecommunication cables, PCM repeaters, etc. which cause hindrance to execution of track elevation work.

2) Gambir Station

The precautions for execution of work at Gambir Station are same as those of paragraph (1) 2) of Section 5.4.3, that is, to carry out the work of temporary installation of signalling and telecommunication systems before commencement of temporary track work by track and civil engineering departments.

With this alternative, withdrawal of existing signalling and telecommunication facilities is made after commencement of train operation on elevated tracks in completion of track elevation work in the entire section.

For execution of this project, it is desirable that temporary provision of and modification to signalling equipment are carried out by using equipment and materials which can be procured in Indonesia such as mechanical signalling systems with the period of time required for procurement and equipment changeover techniques taken into consideration. For execution of telecommunication system installation work, it is not desirable that use of the existing system is disabled even for a short period of time due to track elevation work when the importance of data transmission in a railway transportation system is considered. It is desirable, therefore, new equipment are entirely installed without reuse of existing equipment, except for facsimile equipment.

5.5 Investment Scale and Construction Time Schedule

In this paragraph, we are going to examine the investment scale and the schedule required for realization of facilities planning, electrification facilities planning and signalling and telecommunication facilities planning which have been technically studied up to the previous paragraph.

5.5.1 Preconditions for Calculation of Construction Cost

(a) The construction cost was calculated for each kind of construction works with labor cost, machinery cost, materials cost and overhead taken into account.
  - The construction cost was calculated with international bidding as preconditions.
  - The construction unit price is as of July, 1981, and escalation factor is not taken into account.
  - It is assumed that tax-free treatment is applicable to imported machinery, equipment and materials.
  - Construction cost was calculated as classified into foreign currency and domestic currency.

(b) Classification of foreign currency and domestic currency was made based on the following conditions.

Foreign currency
- Imported machinery, equipment and materials
- Foreign currency portion of machinery, equipment which can be produced in Indonesia
- Salary for foreign engineers
- Expenses of foreign contractors

Domestic currency
- Domestic currency portion of machinery, equipment and materials which can be procured in Indonesia
- Salary for domestic workers
- Expenses of domestic contractors

(c) Unit prices of labor cost, material cost, machinery and so forth were set with results of construction works in Indonesia and Japan used as references. The main labor unit prices in Indonesia are that shown in Table 5.5.1.

Table 5.5.1 Labor Unit Prices

Type of Labor	Unit	Wage (Rp.)	
		Min.	Max.
Rough Worker	man/day	1,500	1,500
Chief Worker	"	2,000	2,500
Electrician	"	2,000	2,500
Carpenter	"	3,000	3,500
Superintendent	"	3,000	3,500
Ston Worker	"	2,500	3,000
Steel Worker	"	2,000	2,500
Painter	"	2,000	2,500
Blacksmith	"	1,500	1,750
Earth Worker	"	700	750

Data: Daftar Harga Satuan Bahan Bangunan Dl. JAKARTA

- The main materials unit prices in Indonesia are that shown in Table 5.5.2.
- The main expenses for construction machinery in Indonesia are that shown in Table 5.5.3.

(d) Land purchase expenses and house compensation expenses were calculated with data of DK1 Jakarta used as references.

(e) A value equivalent to 12% of the construction cost was allowed as the design and supervision expenses.
(Survey and design to 15%, supervision expenses for 10% in the case of electric facilities)

(f) A value equivalent to 15% of the total of construction cost, land purchase expenses, house compensation expenses and design and supervision expenses was allowed as the contingency (5% in the case of electric facilities)

(g) Foreign currency exchange rate are as follows:

Rp. 630 = US$ 1.00 = ¥230

5.5.2 Investment Scale

The investment scale of the Central Line Track Elevation Project was calculated for each of three Alternatives A, B and C which were selected as a result of technical study.

The investment scale for the Alternative is summarised as follows.

Table 5.5.2 Material Cost for Construction

	Principal Materials	Unit	Material Cost		Remarks
			Domestic Supply	Foreign Supply	
1.	Sand	Rp./m^3	9,000		for concrete, on site in Jkt.
2.	Gravel	Rp./m^3	11,000		Crushing store (20 mm) for concrete, on site in Jkt.
3.	Cement	Rp. ton	48,750		in bag (40 kg/bag), on site in Jkt.
4.	Ready Mixed Concrete	Rp./m^3	43,000		K225 (=Fc186) Cement contents 320 kg, on site in Jkt.
5.	Timber (Hard Wood)	Rp./m^3	160,000		Kamper timber, on site in Jkt.
	Timber (Soft Wood)	Rp./ton	90,000		Borneo timber, on site in Jkt.
6.	Steel (Angle, Channel, I-beam, etc.)	Rp./ton	276,000		L–50x50x6 L=6m on site in Jkt.
7.	Concrete Pile ϕ400 x 75 mm	Rp./m^3	ϕ300 x 60 15,000 ϕ400 x 75 25,000		P.C. pile produced in Kuala Tanjung incl. transportation to L.S.M. in Sumatera.
	Cast-in-Place Pile ϕ500	Rp/m^3	59,000		Pedestol pile ϕ500 L = 15 m 125 ton. Max Rp. 886,000/Nr. in Jkt.
8.	Embankment Cost	Rp./m^3			
9.	Cutting Cost	Rp./m^3			
10.	Electricity	Rp./kwh	17		100–200KVA 18:00–22:00 26 Rp/kwh 5 Rp/kwh 22:00–18:00 19 Rp/kwh
11.	Gasoline	Rp./Lit.	150		
12.	Heavy Oil	Rp./Lit.	37.5		
13.	Light Heavy Oil	Rp./Lit.	52.5		

Data: Market Price in JAKARTA

Table 5.5.3 Principal Construction Machine

Type	Speck	C.I.F. Price	Value of Lease	Fuel Cost	Remarks
Bulldozer	D80A–18	33,000,000 (Yen/Nr)	40,000 Rp/Hr	1,700 (Rp/Hr)	
Angledozer					
Dump Truck	12.5T ZM802	8,000,000		950	
Concrete-mixer	$75M^3$ /H EMC–1500	46,000,000		Elec.	
Pile Driver	95T IPD–90R650B	76,000,000		600	
Earth Drill					
Tractor Shovel	$1.8M^3$ D65S–6	18,000,000		1,000	
Shovel Type Excavator	LS2800AJ	17,500,000	30,000 Rp/Hr	1,000	
Road Roller	KD7610	6,000,000		360	
Tired Roller	95–15T TS–7409	7,900,000		500	
Vibrating Roller	7T JV32W VE22A	4,000,000	34,500 Rp/Hr	500	
Compressor	17M3/Min. PDS–600S	8,000,000		1,500	
Generator	200KVA EG200–1	8,000,000		2,200	

Data: Market Price in JAKARTA

(a) Alternative A

This alternative aims at construction works for elevated tracks during suspension of train operation on the existing line. As total suspension on the whole elevated section poses a problem with passenger transport, the section is divided into two; the section between Jakarta Kota and Gambir will be constructed in the first period and the section between Gambir and Manggarai in the second period.

As compared with other alternatives, this alternative is low in total construction cost because of small amount expenses of land purchase and house compensation for construction of service roads and bridge structures. (Service roads : 3,900 m^2. Bridge structures and temporary track space : 9,500 m^2. Station front areas: 28,000 m^2)

(b) Alternative B

This alternative, which aims at the passenger transport by single track operation on the existing line during track elevation works, complement for the demerits of Alternative A in passenger transport. But train meeting facilities are needed at Sawah Besar Station and Cikini Station due to shortage of track capacity resulting from single track operation. Construction of bridge structures is rather high in cost, because safety protection such as guard fence should be taken due to work execution in proximity to the existing line. This alternative is higher expenses in land purchase and house compensation than Alternative A.

(Service roads : 15,700 m^2, Bridge structures and temporary track space : 23,500 m^2, Station front areas: 28,000 m^2)

(c) Alternative C

This alternative is to construct elevated tracks while double track operation is continued on the existing line.

It is very convenient for passengers and has a merit of securing the space for future track addition in the land after removal of existing tracks upon completion of the elevated tracks.

Due to work execution in proximity to the existing line like the case of Alternative B, it is rather high in cost for bridge structures and incurs increase of land purchase and house compensation expenses. (Service roads : 17,300 m^2, Bridge structures and temporary track space : 51,000 m^2, Station front areas : 28,000 m^2)

The construction costs based on the above execution planning are calculated as shown in Table 5.5.4 ∿ 6. Judging from the results of demand forecast, new stations will have only to be constructed by 1995 and so construction cost of new stations (Jayakarta, Mangga Besar, Juanda, Gondangdia) is calculated separately from initial investment.

Table 5.5.4 Investment Scale : Alternative A

(Unit: Rp)

Classification of work \ Investment	Unit	Quantity	Unit Price x 10^3	Investment 10^{x6} Foreign currency	Domestic currency	Total
1. Civil and Building Work						
Earth work	m	300	800	82	158	240
Bridge structure	m	8,200	4,392	18,937	17,077	36,014
Track	m	17,000	343	3,532	2,299	5,831
Station building	m^2	7,600	746	3,653	2,017	5,670
Station front area	m^2	22,000	36	345	447	792
Temporary track work	set	1	1,516	905	611	1,516
Subtotal				27,454	22,609	50,063
2. Electrification Work						
Substation facilities	set	1	2,260,000	1,780	480	2,260
Overhead line facilities	km	8.5	545,180	2,690	1,944	4,634
Lighting power facilities	set	1	2,267,000	1,507	760	2,267
Subtotal				5,977	3,184	9,161
3. Signal and Telecommunication Works						
Crossing protection facilities	place	19	3,050	11	47	58
Signalling facilities	set	1	972,000	682	290	972
Signalling cable	km	17.0	6,760	74	41	115
Track circuit	km	9.5	32,630	250	60	310
Telecommunication facilities	set	1	531,000	353	178	531
Subtotal				1,370	616	1,986
4. Land Purchase and House Compensation						
Service road	m^2	3,900	252	0	983	983
Station front area	m^2	16,000	250	0	4,000	4,000
Bridge structure	m^2	9,500	236	0	2,242	2,242
Subtotal				0	7,225	7,225
5. Total				34,801	33,634	68,435
6. New Station Construction						
Civil and building works	place	4	2,757,250	6,218	4,811	11,029
Electrification/Signalling/ Telecommunication works	place	4	77,000	189	119	308
Land purchase and house compensation	m^2	12,000	250	0	3,000	3,000
Subtotal				6,407	7,930	14,337
7. Grand Total				41,208	41,564	82,772

Note: New stations to be constructed are Jayakarta, Mangga Besar, Juanda and Gondangdia.

Table 5.5.5 Investment Scale : Alternative B

(Unit: Rp)

Classification of works \ Investment	Unit	Quantity	Unit Price x 10^3	Investment 10^{x6} Foreign currency	Domestic currency	Total
1. Civil and Building Work						
Earth work	m	300	913	96	178	274
Bridge structure	m	8,200	4,828	20,059	19,531	39,590
Track	m	17,000	343	3,532	2,299	5,831
Station building	m^2	7,600	746	3,653	2,017	5,670
Station front area	m^2	22,000	36	345	447	792
Temporary track work	set	1	3,103	2,007	1,096	3,103
Subtotal				29,692	25,568	55,260
2. Electrification Work						
Substation facilities	set	1	2,260,000	1,780	480	2,260
Overhead line facilities	km	8.5	690,240	3,403	2,464	5,867
Lighting power facilities	set	1	2,442,000	1,624	818	2,442
Subtotal				6,807	3,762	10,569
3. Signal and Telecommunication Works						
Crossing protection facilities	place	19	12,580	47	192	239
Signalling facilities	set	1	1,791,000	1,049	742	1,791
Signalling cable	km	17	8,880	96	55	151
Track circuit	km	9.5	31,680	246	55	301
Telecommunication facilities	set	1	504,000	312	192	504
Subtotal				1,750	1,236	2,986
4. Land Purchase and House Compensation						
Service road	m^2	15,700	218	0	3,423	3,423
Station front area	m^2	16,000	250	0	4,000	4,000
Bridge structure	m^2	23,500	215	0	5,053	5,053
Subtotal				0	12,476	12,476
5. Total				38,249	43,042	81,291
6. New Station Construction						
Civil and building works	place	4	3,144,000	6,980	5,596	12,576
Electrification/Signalling/ Telecommunication works	place	4	77,000	189	119	308
Land purchase and house compensation	m^2	12,000	250	0	3,000	3,000
Subtotal				7,169	8,715	15,884
7. Grand Total				45,418	51,757	97,175

Note: New stations to be constructed are Jayakarta, Mangga Besar, Juanda and Gondangdia.

Table 5.5.6 Investment Scale : Alternative C

(Unit: Rp)

Classification of work \ Investment	Unit	Quantity	Unit Price x 10^3	Investment 10^{x6} Foreign currency	Domestic currency	Total
1. Civil and Building Work						
Earth work	m	300	913	96	178	274
Bridge structure	m	8,200	4,828	20,059	19,531	39,590
Track	m	17,000	343	3,532	2,299	5,831
Station building	m^2	7,600	746	3,653	2,017	5,670
Station front area	m^2	22,000	36	345	447	792
Temporary track work	set	1	4,170	2,682	1,488	4,170
Subtotal				30,367	25,960	56,327
2. Electrification Work						
Substation facilities	set	1	2,260,000	1,780	480	2,260
Overhead line facilities	km	8.5	627,060	3,087	2,243	5,330
Lighting power facilities	set	1	2,330,000	1,537	793	2,330
Subtotal				6,404	3,516	9,920
3. Signal and Telecommunication Works						
Crossing protection facilities	place	19	12,260	47	186	233
Signalling facilities	set	1	1,394,000	860	534	1,394
Signalling cable	km	17	7,880	85	49	134
Track circuit	km	9.5	32,950	255	58	313
Telecommunication facilities	set	1	471,000	293	178	471
Subtotal				1,540	1,005	2,545
4. Land Purchase and House Compensation						
Service road	m^2	17,300	211	0	3,650	3,650
Station front area	m^2	16,000	250	0	4,000	4,000
Bridge structure	m^2	51,000	207	0	10,557	10,557
Subtotal				0	18,207	18,207
5. Total				38,311	48,688	86,999
6. New Station Construction						
Civil and building works	place	4	3,451,500	7,301	5,785	13,806
Electrification/Signalling/ Telecommunication works	place	4	77,000	189	119	308
Land purchase and house compensation	m^2	12,000	250	0	3,000	3,000
Subtotal				7,490	8,904	16,394
7. Grand Total				45,801	57,592	103,393

Note: New stations to be constructed are Jayakarta, Mangga Besar, Juanda and Gondangdia.

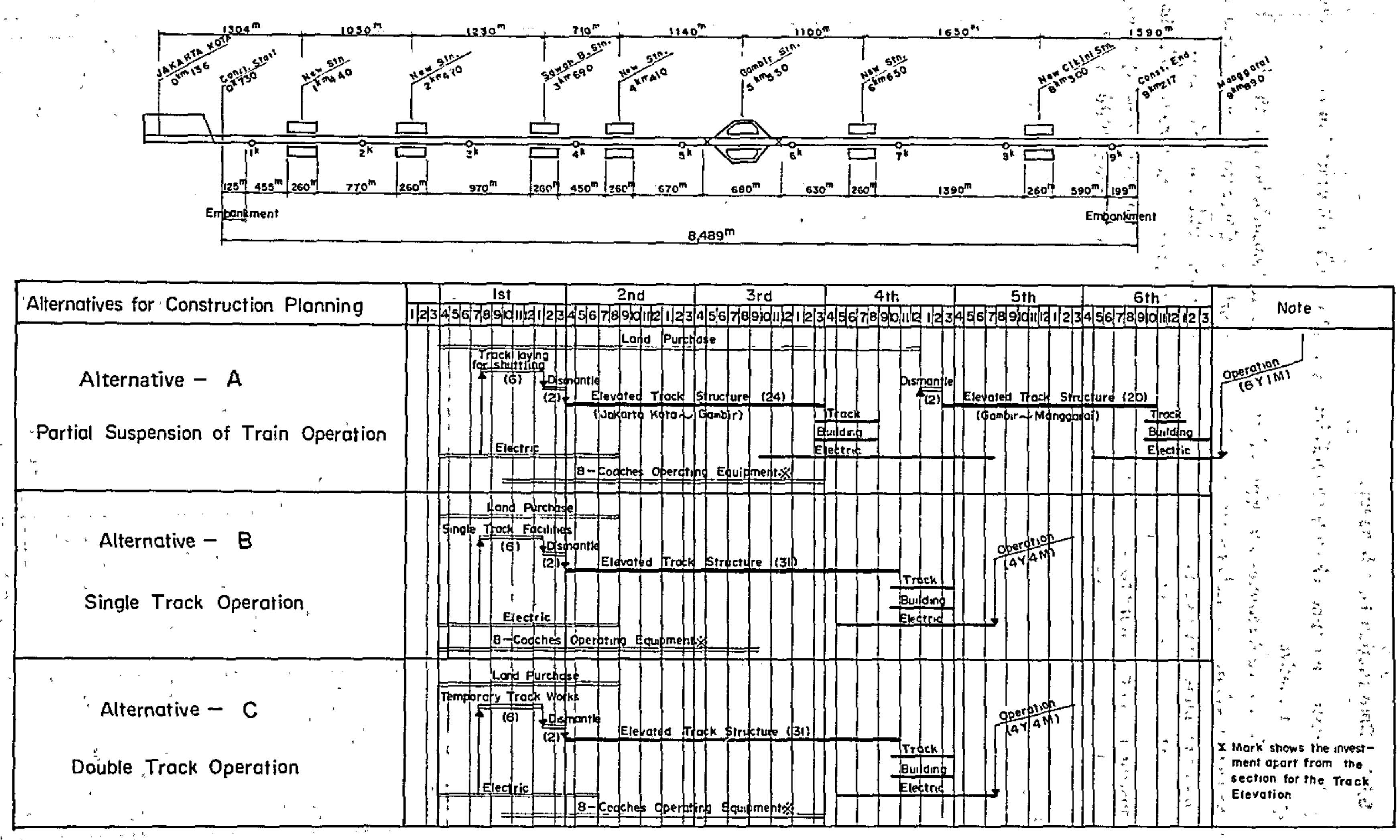
5.5.3 Construction Time Schedule

Construction time schedule extends for 6 years 1 month or 4 years 4 months according to the alternative.

Alternative A requires a long period of time, 6 years 1 month, because the divided two sectors will be separately constructed (3 years 9 months for the sector between Jakarta Kota and Gambir and 2 years 4 months for the sector between Gambir and Manggarai).

Alternatives B and C, requiring only 4 years 4 months, involve dangerous works due to construction in proximity to the existing line, and therefore need a period for safety education and training. The construction time schedule by alternative is shown in Table 5.5.7.

Table 5.5.7 Construction Time Schedule



CHAPTER 6. ENVIRONMENTAL SURVEY FOR TRACK ELEVATION

CHAPTER 6 : ENVIRONMENTAL SURVEY FOR TRACK ELEVATION

6.1 Environmental Preservation

In this paragraph, we are going to examine various elements related to measures for environmental preservation on the construction of track elevation. Among others, the types of noise and their influence are clarified.

6.1.1. Environmental Preservation

Track elevation work project in the metropolis not only permits elimination of crossing roads and recovery of road traffic function, but also is useful as means of urban redevelopment. As faulty planning of the project could exert a bad influence on the dwelling environment in the areas along the line, adequate care is needed for environmental preservation.

Environmental preservation is indispensable and it is essential to take into consideration the effects of air pollution, water quality pollution, contamination of soil, noise, vibration, subsidence of ground, malodor, etc., on one's living environment and one's health.

Turning to the track elevation plan for the Central Line, noises caused by trains might be given main consideration, but in the existing circumstances, conservation and regulations for environmental preservation are not yet established in the city of Jakarta.

Therefore, it would be useful in the study for the track elevation plan of the Central Line to make survey on noise along the Central Line and to make comments on noise based on the result of survey.

6.1.2 Noise and Others

It is very difficult to judge which sound is a noise or not, even when taking character of a person and the conditions into consideration, but from the result of the investigation regarding the relationship between the physical character of noises and the physical and psychological reaction of one person from many persons, the following sounds have been easily understood as noises in general.

That is, 1) strong sound (more 90 db (A), 2) High frequency sound, 3) Sound of irregular form of wave, 4) Wide fluctuating sound, 5) Shocking sound, 6) Sound lasting over a long period, 7) Sound in a quiet environment 7) Sound in the night, etc.

The influences of noise on people, such as interruption of sleep and of conversation in every day life, influence on thought, deterioration of efficiency of work, and discomfort, that is physical and psychological reactions, should be considered.

Some example of noises are shown in general in Fig. 6.1.1.

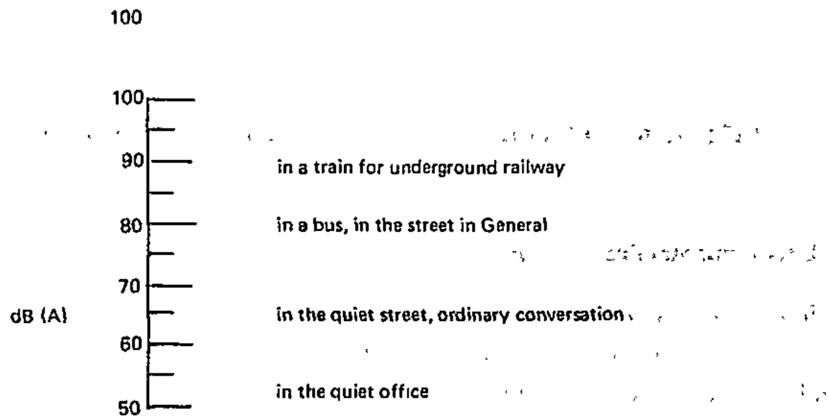


Fig. 6.1.1 Ordinary Noise Level

6.2 Preliminary Environment Assessment

A noise survey was carried out by the Study Team to investigate the present condition of noise along the Central Line, and to relate it to a noise survey already done along the existing elevated line in Japan.

6.2.1 Present Situation

The data of result from the noise survey are mentioned in Fig. 6.2.1 and Table 6.2.1.

Regarding noise caused by trains, the values were unexpectedly high such as from 84 dB (A) to 100 dB (A), though the velocity of train were of 35 km/h or so because of insufficiency of railway facilities.

On the other hand, the values of noises caused by vehicles on the main roads were also high such as from 77 dB (A) to 84 dB (A), and nuisance caused by the road traffic was recognized to be much more than that caused by the railway traffic, because the noise of the former are lasting whereas the noises of the latter are intermittent.

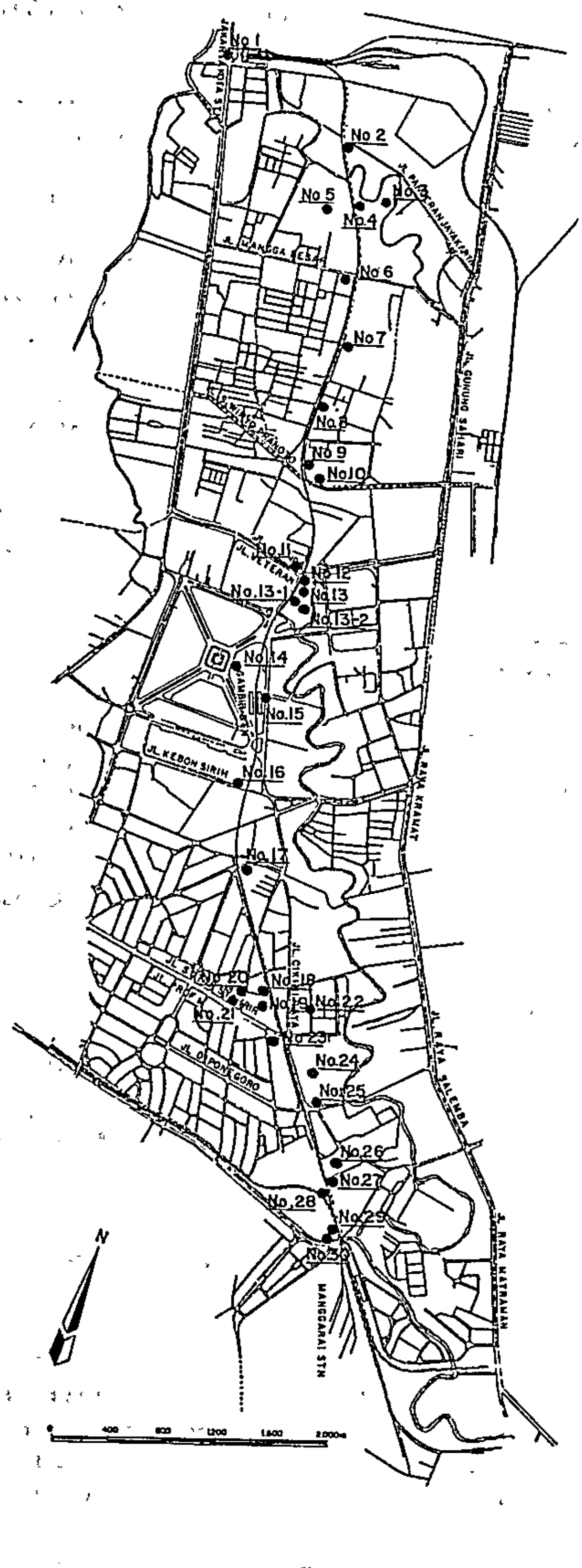


Fig. 6.2.1 Location of Noise Level Survey

Table 6.2.1 Data of Noise

Point No.	Noise Level dB (A)	Location
1.	79	J1. Pintu Besar Selatan
2.	79	J1. Jayakarta
3.	74	J1. Mangga Besar IV
		along the Central Line
4.	*100	1K800M. V = 38 ~ 48 km/h
5.	54	J1. Durian (Houses)
6.	83	J1. Mangga Besat Raya
7.	60	J1. DEP' PENGEMBANGAN INDUSTRI
		along the Central Line
8.	* 90	3K300M. V = 28 ~ 42 km/h
9.	77	J1. Krekot Raya
10.	83	J1. Kh. Samanhudi
11.	80	J1. Juanda
		along the Central Line
12.	* 93	4K950M. V = 28 ~ 47 km/h
13.	63	Mesjid Istiqlal
13-1	65	Mesjid Istiqlal
		2F Railway Side
13-2	60	Mesjid Istiqlal
		2F In the Center
14	77	Front of MONUMENT
15	81	J1. Medan Merdeka Timur
16	76	J1. Kebon Sirih
17	78	J1. Cut Mutiah
		along the Central Line
18	* 92	7K750M. V = 34.47 km/h
19	62	side of SCHOOL
20	79	J1. Teuku Cik Ditiro
21	83	J1. Sutan Syahril
22	67	J1. Sutandiri (Houses)
23	82	J1. Cilacap
		Campus
24	54	Universitas Indonesia
25	83	J1. Diponegoro
		Gedung Perintis
26	60	Kemerdekaan (Center of Park)
		along the Central Line
27	* 90	9K130M. V = 18 ~ 33 km/h
28	* 85	9K320M. V = 17 ~ 41 km/h
29	* 84	9K580M. V = 15 ~ 20 km/h
30	84	J1. Manggarai Utara

Note: * Mark is shown the survey point along the railway line.

6.2.2 Noise Level Caused by Train

Noise caused by trains are dependent of the kind of railway track, condition of maintenance of railway track, the track structure, the velocity of train and so on.

As for the elevated track structure, which has been made of concrete with ballast and long rails in Japan, there have been no problems of noise although the velocity of trains is of 95 km/h or so.

Therefore, it will be recognized that noise caused by trains running on the elevated track structure of the Central Line at the maximum speed of 90 km/h would be less than that of the existing line.

The value of noise caused by trains in Fig. 6.2.2 is the comparison between that of the level line and that of the elevated line in the case of Japan.

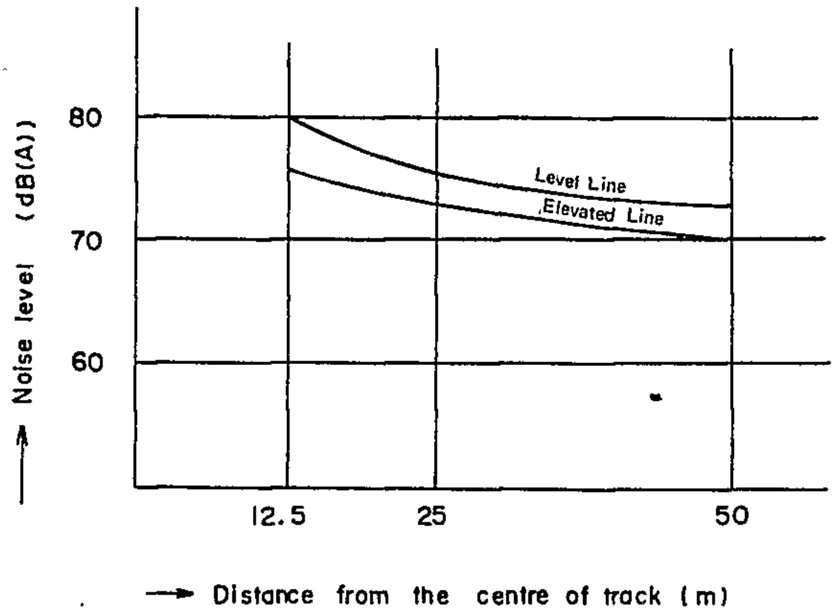


Fig. 6.2.2 Comparison of noise between level line and elevated line

6.2.3 Some Environmental Consideration

Needless to say RAILWAY is a track transportation system, which enables carrying large volume at continuous high-speeds. It means that RAILWAY is the appropriate transportation mode to handle a massive commuter traffic.

Recently, in main cities in the world, RAILWAYS have become in the spotlight again, and improvement and new construction plans of railways are being executed rapidly, because the road transportation has nearly reached being its limitation, which causes many problems such as the deterioration of the economic efficiency by traffic congestion, air pollution, environmental destruction, etc.

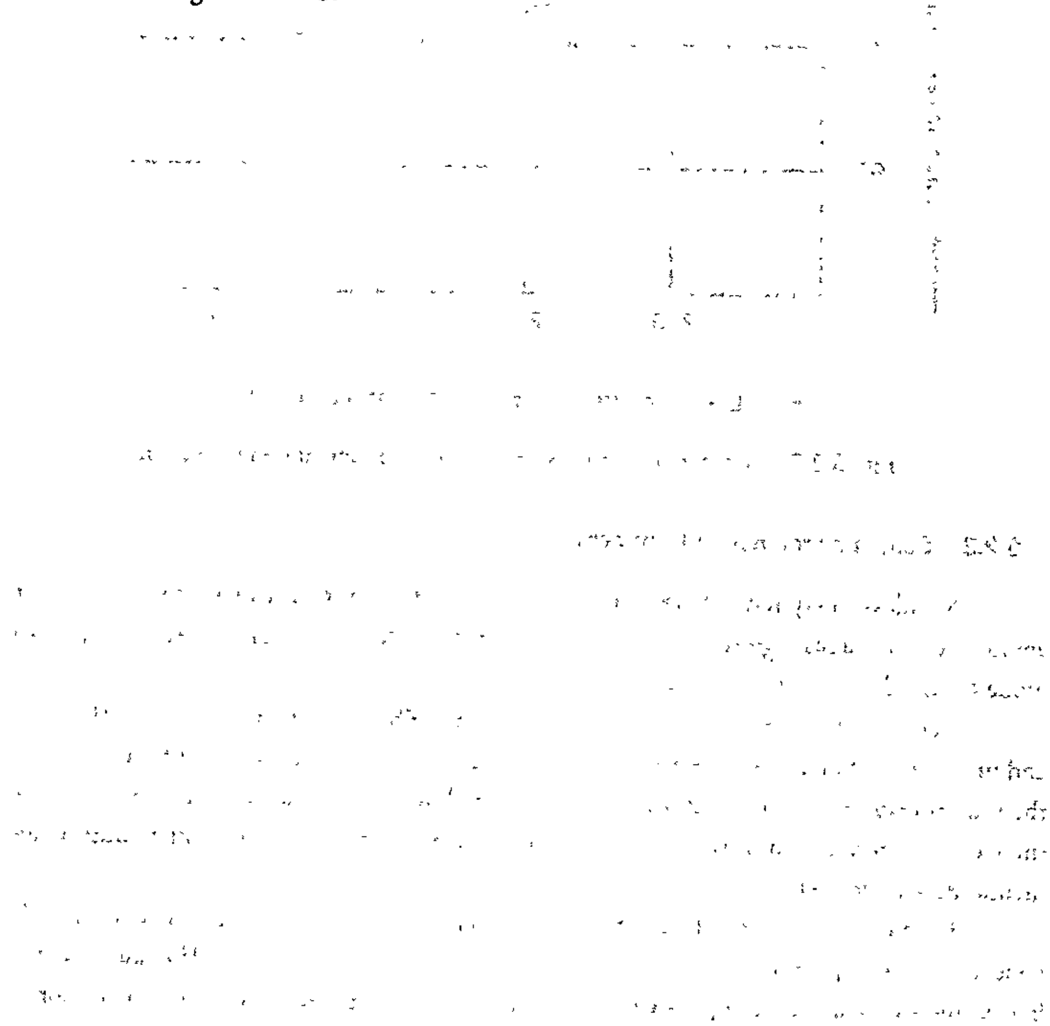
Recently, in the city of Jakarta, the number of motorcars is rapidly increasing and it is believed that this phenomenon will continue. Strictly speaking in road traffic, autobicyle, bajajs, and cars maintain a superior position, but at present, because there are no laws or regulations to officially check cars, many are in use improperly equipped, and noise caused by cars is not controlled. It is hoped that in the future this will be remedied, taking whatever measures are necessary.

With such conditions existing in the city of Jakarta, it should be recommended to make the Central Line an elevated line as the present system has 19 level crossings. Although the track elevation plan for the Central Line presents some problems concerning the acquisition of railway land, these should be settled to make the function of the metropolis efficient.

There would be no infringement upon the privacy of private houses by being overlooked by railway passengers, as trains would pass any point in an instant.

To avoid any intrusion at the site of Mosques, etc., the placing of a visual barrier could be considered from the view point of city planning. It is difficult to make judgment, in accordance with an objective standard, on the effects of the elevated track or of the tollway on the scene of the city.

However, in case of elevated track structures through the center of the urban area it is expected to spoil scenic harmony with the areas along the line. Such discordance can be mederated by planting of trees or by arrangement of sidewalks. An example of scenic preservation is shown in Fig. 6.2.2 ~ 3.



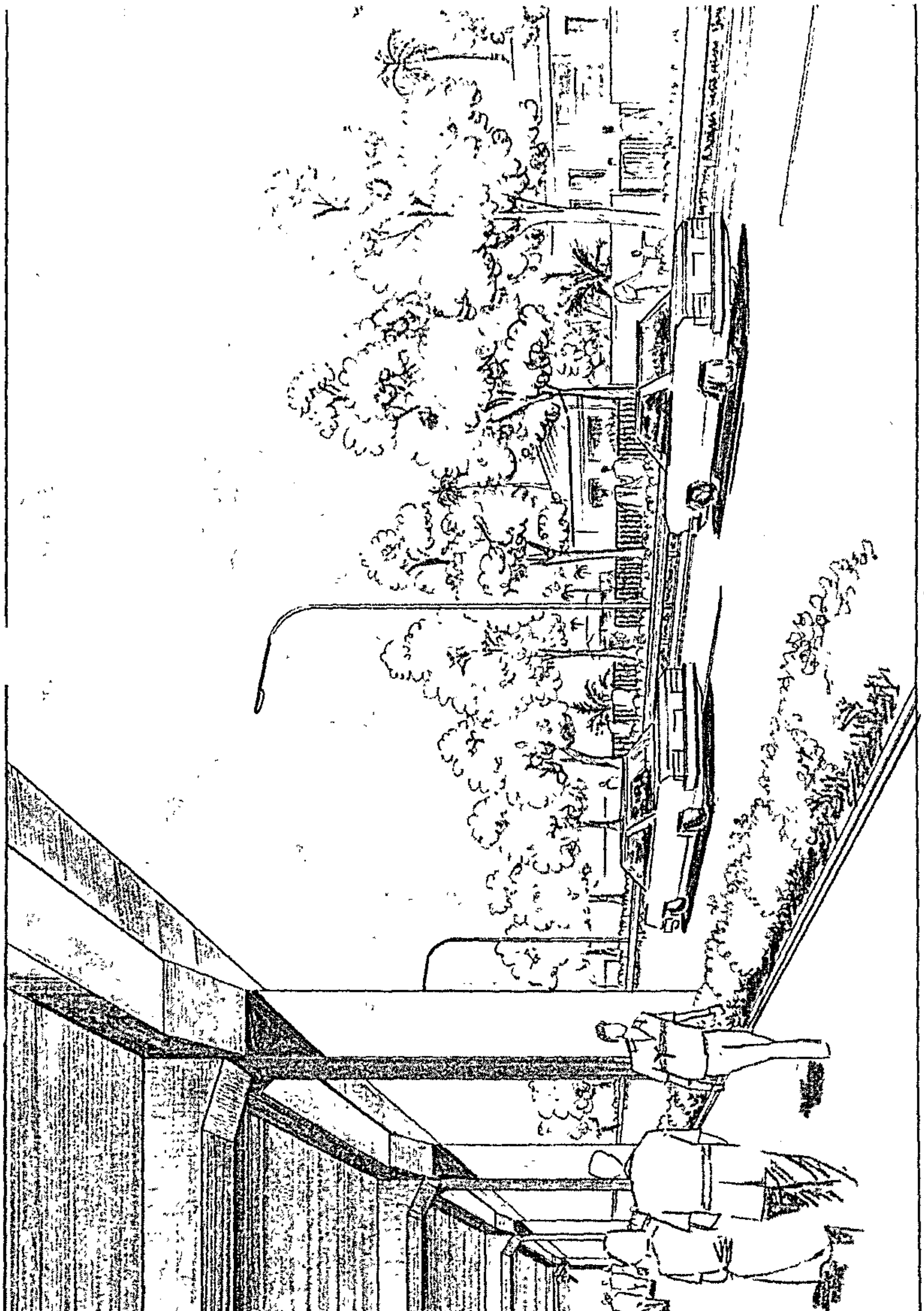


Fig. 6.2.3 Countermeasure for Scenery

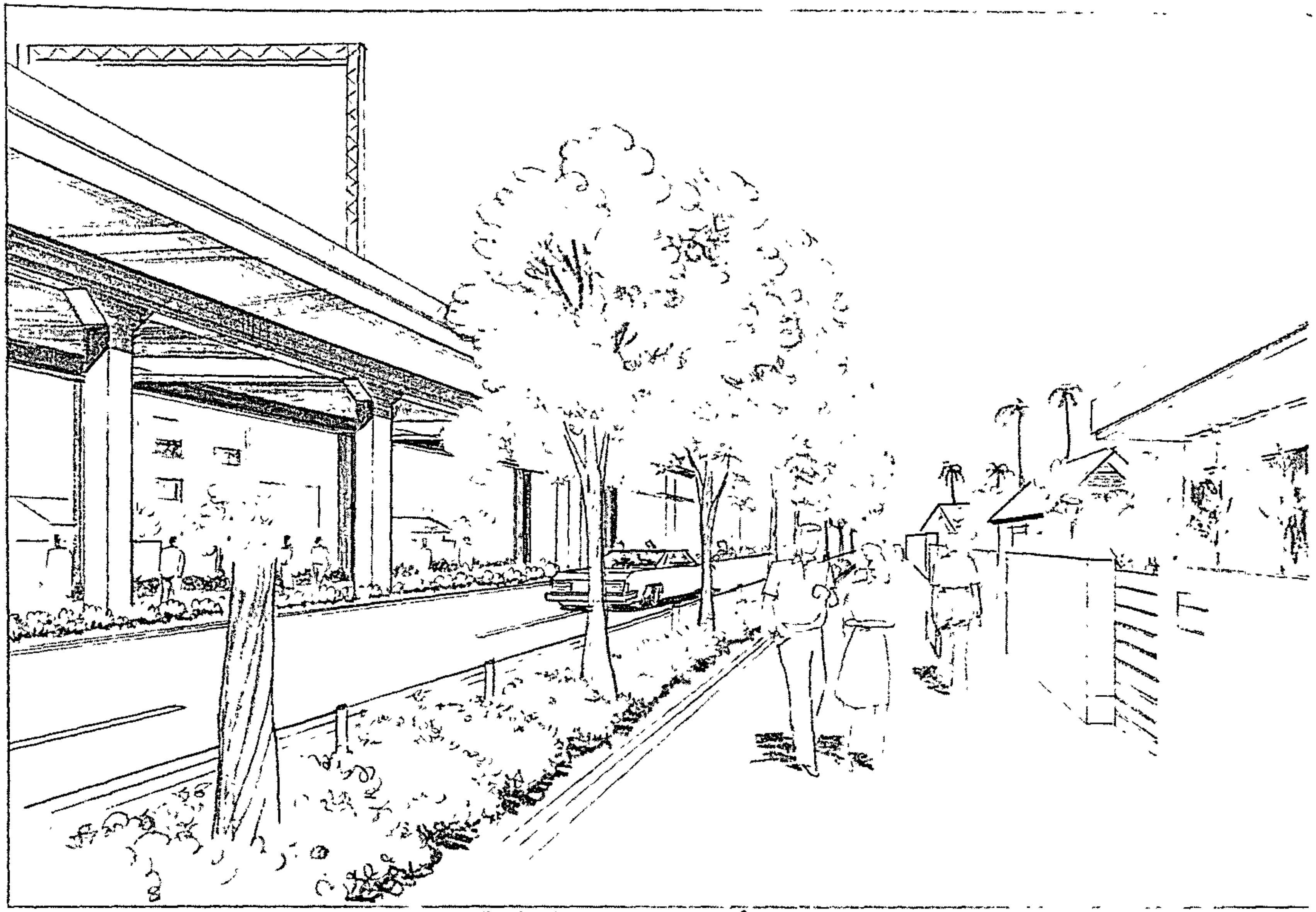


Fig. 6.2.4 Countermeasure for Scenery

CHAPTER 7. ECONOMIC ANALYSIS

CHAPTER 7 ECONOMIC ANALYSIS

7.1 Methodology

7.1.1 "With/without" analysis

This analysis is based on a comparison between the cases of the project being implemented and not being implemented. Taking into consideration the construction method, and the manner of handling the transportation demand and the maintenance of safe operations of the railways during the construction period, the manner of implementing this project shall be confined to the three alternatives proposed below.

This economic analysis uses a comparison of the following three alternatives "With the project" and "Without the project" respectively in terms of construction cost, operating & maintenance cost, and benefits attributable to the project.

1) Proposal for successive construction period with partial suspension of operations (partial suspension proposal):
The construction work shall be divided into two sections, namely from Jakarta to Gambir and from Gambir to Manggarai. Initially, railway operations between Jakarta–Gambir shall be suspended while the elevated tracks are being constructed over the existing track. After completion of this work, operations on the (Gambir–Manggarai) section shall likewise be suspended while the elevated tracks are being constructed over that section.
2) Proposal for construction while maintaining single track operation (single track proposal):
The construction of the elevated tracks shall be carried out over the entire length of the line while maintaining single track operation.
3) Proposal for construction while maintaining double track operations (double track proposal):
The elevated tracks shall be constructed along side the current railway throughout the railway line while maintaining double track line operations under normal schedules.

Even if the project is not implemented ("Without the project"), the Master Plan calls for harmonious development of the facilities on the Central line (explained below) with the overall development of the railway facilities and the future urban development plans in the Jabotabek area, which will result in clearing traffic congestion at some railway crossings.

1) Replacement (Note 1) & modernization of obsolete railway facilities
   ① Replacement of the facilities which have exceeded their life limits.
   ② Modernization of signals & telecommunication facilities, including automatic signals & ATS
   ③ Improvement of the existing railway stations, including the improvement of the platform of the Gambir station and construction of overbridges.
   ④ Construction of new stations
   5 new stations are proposed to be built at appropriate distances between stations in

accordance with the urban transportation system. (This is the same as in the case that the project is implemented.)

⑤ Coordination with the urban development program

i) Removal of illegally occupied houses to secure the right of way.

ii) Improvement of the squares in front of the stations.

(Note 1) This analysis was made on the assumption that the Intermediate Program had been completed, meaning the majority of the tracks, signals & telecommunication facilities had been rehabilitated.

2) Construction of flyovers to eliminate traffic congestion at railway crossings

The following 5 flyovers will be constructed for the reasons described in 1.2.4.

	'85	'86	'87	'88	'89	'90	'91	'92
Jl. Mangga Besar			←	—	→			
Jl. Sukarjo Wiryokranoto						←	—	→
Jl. Juanda	←	—	→					
Jl. Cut Mutiah					←	—	→	
Jl. Diponegoro					←	—	→	

7.1.2 Alternative proposals for the case "with the project"

The aforesaid 3 proposals cause differences with respect to 1) the method of construction, 2) the construction schedule, 3) the measures for handling passengers during the construction period, 4) appurtenant work, 5) benefits & losses from detouring, etc.

1) Partial suspension proposal

① Difference in construction cost stemming from the difference in method of construction

Since the elevated track shall be constructed over the existing tracks, the cost for acquisition of land is very low. There is no need for special safety measures for construction workers during the construction period.

② Measures to cope with transportation demands during the construction period

i. Detour

– The Jakarta Kota – Gambir construction period:

Normal operations are possible between Gambir and Manggarai. It is assumed that the potential passengers between Gambir and Jakarta Kota shall utilize buses from Gambir to Jakarta Kota rather than detouring by the use of the western line or the eastern line.

– The Gambir – Manggarai construction period:

It is assumed that passengers utilizing the central line between Manggarai and Jakarta Kota shall utilize the western and the eastern lines and get off at the stations nearest to their destinations. Refer to Chapter 3 for the details of the operation plans.

ii. Acceleration of railway investment to handle potential passengers during the construction period:
It will be necessary to operate eight-car trains by the year 2,000 in the Jabotabek area. Under this proposal, there will be no need to accelerate the implementation of the project.

③ Schedule
The construction work shall be divided into 2 sections with each section being undertaken successively. As a result, a long construction period will be necessary. The first phase of the work will need 3 years and 9 months, and the second phase 2 years & 4 months. A total of 6 years & 1 month will be necessary.

④ Loss of time in detouring during the construction period
There will be a time-loss caused by detouring passengers to the western and the eastern lines during the Gambir–Manggarai construction period.

2) Single track operation proposal

① Difference in the construction cost stemming from the difference in the method of construction
Only a single track will be used during the construction period. Thus, the cost for acquisition of land will be comparatively low, since the elevated track shall be constructed along side the single track line. However, it will be necessary to implement special safety measures for construction workers, as the single track operation shall be maintained.

② Measures to cope with the transportation demands during the construction period

i) Changes in schedules
It will be necessary to change the schedules of operations of the long-distance trains during the peak-operating hours until completion of the eight-car operating facilities in 1987.

ii) Acceleration of the railway investment to handle the transportation demands of potential passengers during the construction period
Under this proposal, it will be necessary to accelerate investment by six months for attainment of 8-car operating facilities compared with the case in which this project is not implemented.

③ Schedule
Since the construction work for the whole length of the line shall be undertaken simultaneously, the construction period will be shortened to 4 years & 4 months.

④ Time-loss from detouring during the construction period
In principle, there shall be no time loss.

3) The double track operation proposal

① Difference in the construction cost stemming from the difference in the method of construction
The existing double tracks shall be maintained as they are, and the elevated track shall be constructed on the side of the double track. The cost for acquisition of land will be the highest among the various plans. Safety measures will be necessary since railway operation will be maintained alongside the construction work.

② Measures to cope with the transportation demands during the construction period

i) Change in operations

In principle, there will be no change in operations.

ii) Acceleration of the railway investment to handle the potential passengers during the construction period

In principle, unnecessary.

③ Schedule

The construction work will be simultaneously undertaken for the whole length of the line, making the construction time 4 years & 4 months.

④ Time-loss from detouring during the construction period

In principle, none.

7.1.3 Evaluation

Each of the above proposals will be evaluated by calculating and comparing differences in investment amounts, operation and maintenance costs, and benefits on an annual basis with the case "without the project." This shall be called a "net flow."

The net flow shall be used to calculate the EIRR (Note 2). The results obtained will be the index for evaluation.

This index shall be the general index which integrates the economic values of the following items:

1. Degree of difficulty in the construction work
2. Construction period
3. Degree of difficulty in acquisition of land
4. Assurance of safety of the construction work
5. Acquisition of land for four track line operations in the future
6. Passenger service during the peak operating hours

The following conditions are assumed in the calculation of the Net Flow.

1) The starting years of the construction work shall be the same for all alternatives. The starting years shall be unified in compliance with the request of the Indonesian Government for an early start and early completion.
2) No inflation analysis was made.

(Note 2): The Economic Internal Rate of Return is calculated as follows:

$$0 = \sum_{i=1}^{30} \text{Net Flow } i \,/\, (1 + \text{EIRR})^{i-1}$$

The following are given as additional evaluation indices for reference.

1) Time of completion

The starting years of the construction work were made uniform for comparative purposes. The less the time needed for completion, the higher is the cost of construction, making it less advantageous in terms of EIRR. Thus, the time of completion is an index for evaluation.

2) Creation of job opportunities

Since the creation of jobs is one of the basic policies of the Indonesian Government, the demand for labor to be created by the construction work will be calculated.

3) Energy-saving

Since energy conservation is one of the government's priority policies, the amount of savings in fuel at the railway crossings will be calculated.

4) The degree of land acquisition for the four track line operations in the future.

5) Measures to cope with the transportation demands during the construction period.

Evaluation of the 3 alternatives is undertaken through examination of indices mentioned above.

Sensitivity analyses is conducted by changing conditions of key parameters such as investment amount, traffic demand, an the number of flyover to be constructed.

7.1.4 Assumptions

1) The exchange rate assumed is ¥230 = US$1.00 = Rp.630.

2) Life expectancy of the facilities and reinvestment

Based on the rate of depreciation of PJKA, it is possible to calculate the life expectancy of the facilities. But there are quite a number of items whose classifications do not match those of JNR. The life expectancies as shown in Table 7.2.1 were applied.

3) Inflation

The inflation factor was excluded from the analysis for the reasons given below:

① It is unreasonable to expect accuracy in forecasting the inflation rate over a period of 30 years. If the wrong forecast were used, it is feared that the economic evaluation will be substantially distorted.

② It is thought reasonable to assume that the effect of this project on the prices of the local resources will be immaterial.

7.2 Economic Cost Estimation

7.2.1 Capital cost

Adjustments such as those mentioned below were made on the total financial cost of the construction work, and the economic cost was estimated.

1) Taxes & subsidies adjustment

① Foreign currency portion

Import duties were excluded from the calculation of the financial cost, so adjustment is not necessary.

② Domestic currency portion (materials & equipment)

The manufacturers' taxes paid on the average of 20 % and MPO & PPN with a total of 4.5 % on average were assumed and deducted from the financial cost of the construction work.

2) Reutilization of the written-off assets

Out of the assets such as civil works, and signals/telecommunication investments undertaken under the Intermediate Program, which are to be written off at the time of implementation of this project, the reusable assets were estimated and counted as investment (deduction).

The construction period and allocation of amounts are:

Proposal	Allocation Time	Civil	Signals & Telecommunication	Railway Crossings Station Buildings
Partial suspension proposal	The first year of phase I construction	1/2		1/2
	The first year of phase II construction	1/2		1/2
	The completion year of construction		Total amount	
Single track operation proposal	The first year of starting the construction work	1/2		
	The completion year of construction	1/2	Total amount	Total amount
Double track operation proposal	The completion year of construction	Total amount	Total amount	Total amount

3) Reinvestment
To have a common basis for calculating the investment for the cases of both with and without the project, it is assumed that the same amounts shall be reinvested for all the depreciated assets in the year following the expiration of their life limits.

4) Salvage value
The designated project life of 30 years is the period used for analytical purposes. The railway facilities shall be continued to be used thereafter. Therefore, the residual value (undepreciated value) of the invested capital shall be calculated at the end of the last year of the project and accounted for.

5) Economic price of land
This cost estimation uses productivity of land instead of market prices to measure the price of land in order to eliminate market destortions.
The following indices are utilized to measure the productivity of land, and the ratio which gives the usage of land purchased for the project is shown in table 2.1.1, east side within 100 m zone.

① Commercial area : Sum up of present value of each year's gross income/m^2.
(15.5 %) (185,600 Rp/m^2)

② Housing area and others : Sum up of present value of each year's rent income/m^2.
(84.5 %) (3,000 Rp/m^2)

The economic price of land to be purchased for the project turn out to be 195,644 Rp./m^2 as the weighted average of the sum of present values of commercial and housing area.

6) The summary list of capital cost.

Table 7.2.1

(Unit: Mil.Rp)

		With the project			Without the project
		Alternative A	Alternative B	Alternative C	
Capital cost categolized by the period.	The first phase (1985 – 1988)	62,470	91,967	98,779	35,194 (9,109)
	The second phase (1989 – 1990)	17,489			16,583 (16,583)
	The reinvestment (1991 –)	2,765	3,516	3,222	1,853
Capital cost categolized by the kind of work	Civil work	58,128	65,251	67,441	30,387 (14,431)
	Land acquisition	9,040	14,628	20,857	17,356 (11,261)
	Electric facilities	9,477	11,348	10,145	3,436
	Signals & telecommunication	2,635	4,255	3,555	2,452
The financial cost due to the acceleration of investment for attainment of 8-car operation facilities	Civil work	0	0	0	
	Electric facilities	0	724	0	
	Signals & telecommunication	0	4	0	
Total Capital Cost		82,724	95,483	102,001	53,630

Note: The figures within parenthesis show the capital cost for the flyovers.

7.2.2 Differences in Maintenance & Operating Costs

1) Maintenance cost difference

In the estimation of the maintenance and replacement cost of the railway facilities, the estimating method used by JNR was applied in the absence of any other appropriate method.

① Maintenance cost of the depreciated assets

= Maintenance ratio (Note 3) x total of undepreciated value of the depreciated assets

② Maintenance cost of the replacement assets

= 0.95/Life expectancy x maintenance ratio (Note 3) x total of replacement assets

③ Replacement cost of the replacement assets

= 0.95/Life expectancy x total of replacement assets

(Note 3) Refer to Table 7.2.2 for the maintenance ratios of the assets.

(Note 4) The following amounts were provided as maintenance cost and replacement cost during the construction period for the case "with project."

Proposals		Maintenance & Replacement Cost
Partial suspension proposal	Prior to completion of Phase I	1/2 of the case "without project"
	Prior to completion of Phase II	Equal to the maintenance & replacement cost of the phase I assets
Single track operation proposal		1/2 of the case "without project"
Double track operation proposal		Equal to the amount under the case "without project"

Table 7.2.2 Maintenance Ratios and Life Expectancies of Assets

		Maintenance Ratio	Life Expectancy	(Note 5) Type of Assets
Civil work	Foundations	0.0004	57	Depreciated assets
	Elevated track structure	0.0027	50	〃
	Platforms	0.0041	32	〃
	Overbridges	0.0051	32	〃
	Station buildings (RC)	0.0067	45	〃
	Buildings (RC)	0.0057	45	〃
	Tracks	0.15	25	Replacement assets
Signals and tele-communication	Safety measures at the railway crossings	0.0292	12	Depreciated assets
	Signals	0.0210	20	〃
	Telecommunication equipment	0.0312	9	〃
	Signal lines	0.035	35	Replacement assets
	Communication lines	0.12	35	〃
	Track circuits	0.035	19	〃
Electrical works	Transformer equipment	0.0008	20	Depreciated assets
	Buildings for transformer stations	0.0057	45	〃
	Overhead contact wires	0.03	45	Replacement assets
	Electrical distribution wires	0.15	30	〃

(Note 5) Depreciated assets are those assets that are subject to annual depreciation. Reinvestments are to be made on those assets upon termination of their life expectancies.

Replacement assets are those assets that are replaced every year at a predetermined ratio so that the assets are continually renewed.